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GEOGRAPHY OF SCIENCE

SPECIALLY PREPARED FROM THE TARR AND McMURRY SERIES OF GEOGRAPHIES, TO MEET THE REQUIREMENTS OF THE SEVENTH YEAR IN THE PUBLIC SCHOOLS OF THE CITY OF NEW YORK

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NOTE. — It will be seen that the titles in this table of contents are taken from the official syllabus for 7^a. The page numbers show how the requirements can be met from two standpoints, viz. North America and the Eastern Hemisphere, notably Europe.

MATHEMATICAL AND PHYSICAL GEOGRAPHY

GEOGRAPHY OF SCIENCE

Part I

A GENERAL STUDY OF NORTH AMERICA

I. PHYSIOGRAPHY OF NORTH AMERICA

The Growth of the Continent. — There are about one hundred million persons in North America at the present time, although a century ago there were scarcely one-tenth of that number. This wonderful growth has been largely due to the useful and valuable mineral products of the earth; to the soil and climate which have allowed many different kinds of plants and animals to thrive; and to the rivers, waterfalls, lakes, and harbors which have made manufacturing and shipping easy.

As it takes time to build a house, and to prepare the boards from trees, the nails from iron ore, and the bricks from clay, so it takes time for the formation of minerals and rocks and for the building of a continent. In fact, millions of years have been required for that work.

The story telling how North America was made is a very interesting one. It has been discovered by a careful study of the rocks; and although there are many questions that no man is yet able to answer, we are prepared to tell a part of the story.

At one time the earth was probably a white-hot sphere like the sun; but in time the outside cooled to a crust of solid rock. The interior, still heated, continued to shrink and grow smaller, as most substances do when cooling. This caused the solid crust to settle and wrinkle, much as the skin of an apple does when the fruit is drying. Water collected in the depressions forming the oceans, while between them, where the elevation of the earth's crust was greatest, rocks appeared above the sea-level. Thus North America and the other continents were born.

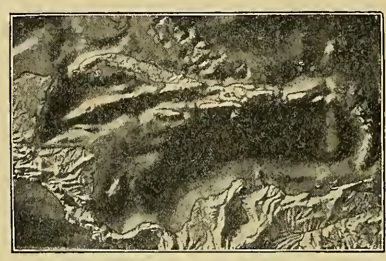


Fig. 1.

A small picture of the West Indian region as it would appear if the ocean water were removed. Notice that the islands rest on a lofty ridge rising from the ocean bottom.

In its babyhood, although the centre of the continent was still a broad sea, the eastern and western parts doubtless resembled the West Indies of to-day, which you will find on the map of North America (Fig. 95, opposite p. 120). Those islands are the highest parts of mountains arranged in a chain. They *seem* to be separated only because the ridges upon which they rest do not rise high enough to reach above the water (Fig. 1).

Although in early times North America consisted of mountain crests forming chains of islands, finally, after many changes, the mountains rose higher, forming a continuous range in the east, and other ranges in the west. Then the plains between the mountains slowly emerged from the ocean, and a large part of the continent came into view.

The Coal Period. — Ages after the beginning, a period arrived when in the northern part of North America it was much warmer than now, and the rains were far heavier. During that period our *coal* was made out of plants. There is good proof that the coal used in our stoves and furnaces is composed of plant remains. Beneath the coal beds, in the rock which was once soil, roots of plants may still be seen, while stems of plants, and even trunks of trees changed to coal, reach up into the coal beds. Also a careful examination with the microscope, or at times even with the naked eye, shows that coal is composed of bits of plants closely pressed together. Frequently the full form of a fern or leaf may be seen (Fig. 2).

FIG. 2.
Rock containing a fossil fern which grew in the swamps of the coal period.

As the crust of the earth shrinks and wrinkles, the land is raised and lowered. Even now it is slowly moving in some places, and was doing the same during the coal period. At that time some of the old sea-bottom was raised above the water, forming extensive plains in the eastern part of North America. Plants had long been growing; and these plains were so low and level that vast swamps were produced (Fig. 3), on which the vegetation was extremely rank, like a tropical jungle. After the swamp plants had grown for hundreds of years, the plains sank beneath the sea, and the vegetation became covered with layers of sand, gravel, and mud, which have since hardened into rock.

After another long period the sea-bottom emerged once more, and the dense swamp vegetation returned; but this time the plants grew with their roots in the ocean mud which had buried the earlier swamp. After many more years the plains again sank, and the swamp vegetation was buried as before. This rising and sinking of the land continued for ages, one set of layers of rock, soil, and vegetation being covered up by another, until many such sets were formed.

FIG. 3.

The way the coal swamps appeared, so far as we can tell from the fossils which have been preserved.

Though the swamps were, no doubt, somewhat similar to those which may now be seen in many places, the vegetation grew far more thickly, perhaps even more thickly than in the jungles of India or the everglades of Florida. Also the plants were so different from those of the present, that not a single species now living grew in the coal swamps.

When the plants died they fell into the water, making a woody matting which did not fully decay, because the water prevented air from reaching it. If it had been dug up and dried, it might have made good fuel. Indeed, it is now the custom in Ireland, Norway, and some other cool, moist lands to dig such matter out of the swamps and dry it, forming *peat*, a fuel used for cooking and heating.

Some of the poorer coals of the West, known as *lignite*, are little more than peat beds partly changed to mineral coal. Other coal, called *anthracite*, found especially in the mountains of Pennsylvania, has been changed so greatly that it is as hard as some rocks, and is known as *hard* coal. But most of the coal that is mined, — as that of western Pennsylvania and the Central States, — although quite like a mineral, and harder than lignite, is not so hard as anthracite. This is called *soft* or *bituminous* coal.

The woody matting that gathered in some of the swamps grew to be scores of feet in thickness; but, on being covered up, it was pressed more tightly together. As the number of layers above increased, causing the pressure to become very great, it gradually changed into coal, making coal beds that are often from six to twelve feet in thickness.

Fig. 4.

A view in the Dismal Swamp of Virginia. Compare Fig. 3 with this to see how different the trees are.

All this time, and at other periods during the formation of the continent, iron, copper, gold, silver, building stones, and other materials that we need every day, were also being slowly formed in the rocks; but we cannot now tell their story.

The Mountains and Plateaus. — During the millions of years that the continent was growing to its present form, there were rising, in the East and West, mountain systems and surrounding plateaus that were to have a great influence upon our climate, and therefore upon our crops, our animals, and ourselves. Being very old and much worn down, the eastern mountains, called the *Appalachians*, are neither very high nor very rugged, though they have some peaks which reach more than a mile above sea level. The western *Cordilleras*, being younger and therefore less worn, are more rugged, and have peaks rising three miles and more above sea level. At the base of the Appalachians is a narrow plateau rarely more than fourteen hundred feet high; but the Cordilleras tower above a broad plateau which is itself more than a mile in height, or as high as the mountain peaks of the east.

Many of the rocks of the mountains and plateaus were deposited as sediment in the sea and afterward raised to their present position by the movements of the earth's crust. In spite of their great elevation, the plateaus have remained level because the rock layers, or *strata*, of which they are made, were kept in a horizontal or level position while being uplifted. This can be seen where rivers have cut deep channels in the earth, showing the layers of rock to be nearly as level as when they were a part of the ocean floor (Fig. 6).

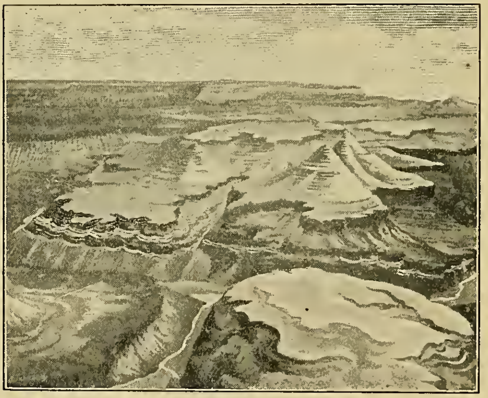


Fig. 6.

This valley, known as the Colorado Canyon, has been cut to a depth of over a mile in the rock strata of the Colorado plateau. Can you see the horizontal strata?

On the other hand, the wrinkling of the earth's crust has in some places broken and folded the rock layers, and formed lofty mountain ranges in which the strata have been tilted and upturned, instead of remaining level (Fig. 7).

Fig. 7.

Tilted layers in the Rocky Mountains of Colorado. They were deposited as horizontal beds in the sea, as those of the Colorado plateau were (Fig. 6); but, during the mountain folding, they have been turned up on end, and then worn away and carved into irregular hills by the rains.

A part of the height of mountains is due to the fact that they rest upon a platform of tablelands about them. Therefore a mountain crest two miles above sea level *may* really rise less than a mile above the plateau at its base.

Mountains are not nearly so high as they would be if they had not been attacked for ages by the weather and the rivers. Not only have they been *lowered* by these means, but also greatly carved and sculptured, being cut into ridges and peaks, and crossed by deep canyons which the rivers have dug out.

After mountains have ceased rising, their peaks are lowered, and their valleys broadened, until they lose much of their mountain character, as in the case of the Appalachians. Indeed, they may even be reduced to a series of low hills, as in southern New England, which is really an ancient mountain region now worn down to its very roots.

The folding, breaking, and sculpturing of the mountain rocks have had an important effect upon mining. As you see from

Figure 8, these changes often bring to view valuable minerals which were formed ages ago and are now deeply buried in the strata.

Some mineral deposits, like coal, were laid down in beds between other layers of rock (p. 4); but many valuable minerals, such as gold, silver, and copper ores, were deposited in cracks of the mountain rock, forming *veins*. Into these cracks

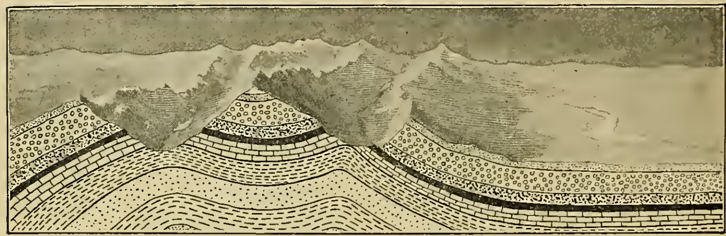


FIG. 8.

A section in the earth, where the rocks are folded, to show how a bed of valuable mineral, such as the black layer, may be brought to light by folding and river cutting, while elsewhere it is deeply buried.

hot water, often heated by deeply buried masses of lava, has brought valuable metals and deposited them in veins. Iron ore also has been deposited by water in beds and veins, though not always by hot water.

Volcanoes. — Hundreds of mountain peaks in the West, instead of being made in the manner just described, are *volcanoes*. These are built of molten rock forced to the surface from within the earth. Though no longer active, these peaks are *known* to be volcanoes because of their cone shape, the hollows or *craters* in their tops, and the lava and volcanic ash, or blown-up lava, of which they are made.

Doubtless some of these volcanoes have recently erupted; indeed, one, Mt. St. Helens in Washington, is reported to have been in eruption about a half century ago. Another, near Mt. Shasta in California, poured forth lava a very short time ago. This is known because the lava flow dammed up a stream, forming a lake whose waters rose into the surrounding forest, and killed the trees; but the trees still stand in the lake, not having had time to decay.

Hundreds of thousands of square miles of this western country are covered by lava flows. The soil produced by decay of the lava is often extremely fertile, and that is one of the chief reasons why the central part of the state of Washington, which is largely covered with it, has become noted for its fruit and wheat. There the lava flowed out from great cracks or

FIG. 9.

Mt. Shasta, California, one of the great volcanic cones of the West, 14,380 feet high, and made entirely of lava and volcanic ash. A smaller cone is seen on the right.

fissures and flooded immense areas of country. The area of the lava flows in the Columbia and Snake river valleys is more than twenty-five times as great as that of Massachusetts.

The Trough between the Two Mountain Systems. — From the mountain systems of the East and West, the land slopes gently toward the Mississippi River, which flows in the trough made by the uplift of the two sides of the continent. Measure the width of this trough on the map of the United States (Fig. 98, p. 123).

This extensive lowland has had a long history, like the mountains. In the early ages so much of it was under water that a great sea extended from where the Gulf of Mexico now lies to the Arctic Ocean. In the rock layers are found many remains, or *fossils*, of shells, corals, and fish that lived in the sea of this ancient time. Upon dying

FIG. 10.

Section across the United States, to show the two highlands and the great trough between. A, Appalachians; M, Mississippi; R, Rocky Mountains.

and dropping to the bottom, these animals were entombed in the beds which have since been hardened to rock.

After a time most of this sea bottom was raised to form dry land, although a part of it — from the Gulf of Mexico to southern Illinois — remained under water for a long time afterward. Into this sea the Mississippi discharged its floods and dropped its load of soil, swept from the distant fields and mountains. As time went on, the river filled up the sea and formed flood plains, which — raised by a slight uplift — are among the most fertile lands of our country. And now the river seems bent on filling up the Gulf itself.

Although the mountains and plateaus of our country are so far away from the lowlands, they have a great influence upon them. The Mississippi Valley, in all but its southern part, is in a belt of the earth where most of the winds blow from the west. Since these winds blow from the Pacific Ocean, they are at first damp; but upon reaching the western highlands, they are compelled to drop much of their moisture, and then they pass on into the Mississippi Valley as dry winds. This causes the plains and plateaus of the northwest to be dry or *arid.* The eastern and southern portions of the valley have a more humid climate. The reasons for this are that this region is so near the Gulf and the Atlantic, and is separated from the latter by such low mountains, that damp ocean winds are able to reach it.

In spite of the fact that most of the West is arid, many rivers have their sources among the high mountains. Notice, for instance, how many tributaries of the Mississippi rise among the mountain ranges (Map, Fig. 97, opposite p. 122). This water carries sediment for hundreds of miles, building it into flood plains and deltas. From this it is evident that the highlands not only supply the Mississippi with much of its water, but also with some of the soil which has made such fertile farm land.

The direction in which the ranges extend is a matter of great importance, also. Since the mountains run north and south, the warm south winds find no highlands to check their northward course. Therefore, they are able to carry warmth and moisture a great distance, even far into the northern part of the United States. In consequence, the Mississippi Valley is one of the largest and finest farming sections in the world, producing a great variety of crops. Where the summers are shortest, though still warm, excellent wheat is raised; farther south, corn is the principal crop; and in the southern part, where the summers are longest and hottest, tobacco, cotton, sugar-cane, and rice are grown.

How different it would be if a great mountain system extended east and west across the continent! The warm summer winds could not, then, carry their warmth and moisture so far north; neither could the north winds, which are cool in summer and cold in winter, reach so far south. The north winds are very important; they moderate the heat of summer and bring cool weather in winter. Sometimes they do damage in winter by causing destructive frosts, even as far south as Florida. Then the orange and lemon trees suffer greatly. But they also do good, for too much heat takes away the vigor of the people, while cool air makes them more active.

The Great Ice Age. — Long after the coal beds were formed and the great highlands and valleys were built,

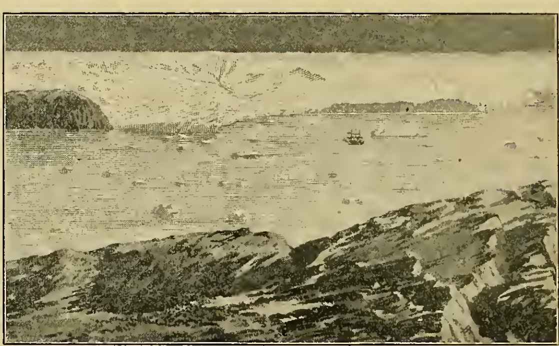


FIG. 11.

A picture of the Cornell glacier in Greenland. It is a great waste of ice, slowly moving down from the interior to the coast and ending in the sea, where icebergs break off and float away. One of these may be seen in the picture (see also Fig. 12).

another very important event happened in the preparation of this continent for our home. That was the formation of a great *ice sheet*, or *glacier*, which covered a large part of northern North America. This glacier had much to do with making the lakes, waterfalls, and even the soil itself, in that section.

An ice sheet similar to that one may still be seen in Greenland (Figs. 11 and 14). Excepting along the very coast, this immense island is buried beneath a sheet of ice which has an area about ten times as great as that of New York State.

The Greenland glacier is made of snow which has fallen on the high interior in such immense quantities that the pressure upon the under part has changed it to ice, as pressure from your hands will change a snowball to ice. As the snow collects and becomes ice, it spreads out, or *flows*, from the interior toward the coast, much as a piece of wax may be made to flow if a weight is placed upon it. Moving toward the sea, the glacier drags away the soil, tears off fragments of the rock, and scours the rock layers, as if it were a great sand paper. The movement is very slow, yet the ice is always pushing onward to the sea, where enormous *icebergs* are continually breaking off and floating away (Figs. 11 and 12).

FIG. 12.

An iceberg from the Greenland glacier, slowly floating southward, where it gradually melts away in the warmer water and air.

The glacier which formerly extended over a part of this continent was likewise made of snow. It covered most of northeastern America, reaching as far south as New York City and the Ohio River, but not so far south in the northwest (Fig. 13). Being over a mile deep in its thickest part, and in consequence very heavy, the glacier swept away the soil which had previously been

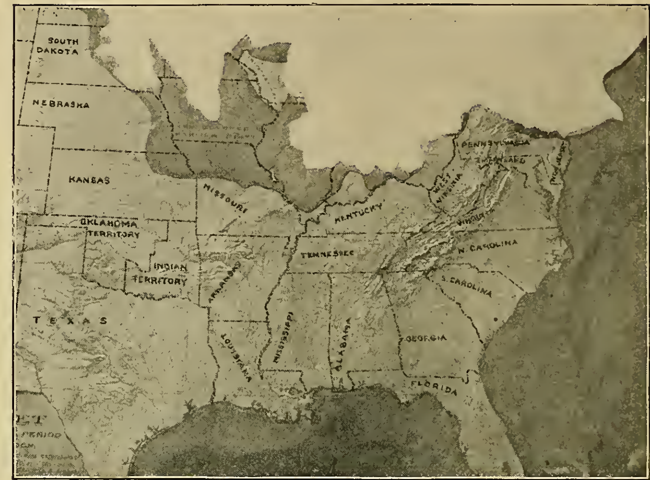


FIG. 13.

Model showing the distance which the Great Ice Sheet reached in United States. (Model made by E. E. Howell, Washington, D.C.)

made. Not only this, but, by the help of rock fragments held fast in its bottom, it scraped off pieces of the solid rock and carried them forward also.

FIG. 14.

The ice front of a part of Cornell glacier (Fig. 11), with moraine at its base, where rock fragments fall from the melting glacier. The dark lower part of the glacier is filled with pieces of rock.

Although the glacier was always pushing southward into our country, its southern end was continually melting away, owing to the warmer climate which it met. At times the movement was just rapid enough to supply the waste due to this melting, so that the edge remained in nearly the same position for years. All this time the sand, gravel, and rock, which had been carried along in the ice, were being piled up along the line where the glacier melted, forming a great mass called a *moraine* (Figs. 14 and 15). The moraine hills, or hummocks, of gravel and clay were often built to a height of one or two hundred feet.

FIG. 15.

Some hummocks in a moraine formed by the Great Glacier near Ithaca, N.Y.

After standing for a while and building a moraine in one place, the glacier front often advanced to the south, or melted away toward the north, building up other irregular piles of moraine hummocks.

During the thousands of years that the glacier lasted, it carried millions of tons of clay and rock from one place to another and built many low hills. As it slipped over the surface, it ground boulders and pebbles together and rubbed them against the solid rock, scratching and grooving it (Fig. 16). Scratches thus made may still be seen pointing northward, toward the place from which the glacier moved. This work of rasping, digging, carrying, and dumping done by the glacier has led to its being called a combined file, plough, and dump cart of immense size.

Finally, after thousands of years, the great ice sheet melted away. No one is able to say why it came or why it went away; but that it *was here* and did the work described, all who have studied the subject are fully convinced.

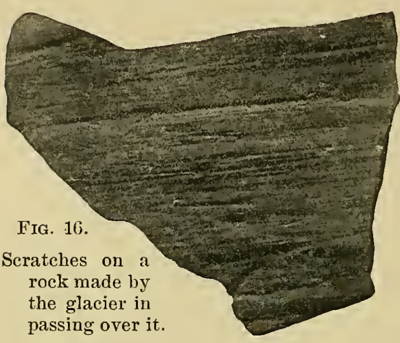


Fig. 16.
Scratches on a rock made by the glacier in passing over it.

It was the glacier which caused the great number of lakes in the northeastern part of North America. Minnesota alone is said to have ten thousand, and in New England there are also thousands (Fig. 17 and Fig. 100, p. 124); but most of the states outside of the glacial region have extremely few.

The manner in which these lakes were formed is as follows: The load of clay and boulders, or *drift*, as it is called, was dumped irregularly over the land. It sometimes filled in valleys and built up dams, behind which ponds and lakes collected. The glacier also formed lake basins by digging, or ploughing, directly into the rock. Even the Great Lakes did not exist before the glacier came; their basins occupy broad river valleys which have been blocked by dams of drift and deepened by the ploughing of the Great Ice Sheet.

The glacier also had an important influence upon our manufacturing. Its load of rock fragments often filled parts of valleys so that, after the ice was gone, the streams were compelled to seek new courses. These courses often lay down steep slopes or across buried ledges, over which the water tumbled in a succession of rapids and falls.

Even the great cataract of Niagara was caused in this way, and the same is true of many of the falls and rapids of hilly New England and New York. The many lakes act as storehouses to keep the noisy falls and rapids well supplied with water. For these reasons New England and New York have such abundant water-power that they early grew to be the greatest manufacturing centres of the Union. In sections of the country not reached by the glacier, rapids and falls are much less common. Did the glacier reach where you live?

Fig. 17.

A New England lake formed by a dam of drift left by the glacier. It is very irregular because the water behind the dam has risen into many valleys, leaving only the hilltops above the surface.

A third important influence of the glacier was upon the soil. In most other parts of the country the soil has been made by the *decay* of rock (see First Book, p. 2); but in the glacial region the decayed rock was swept away and replaced by drift brought by the glacier. This was made by the grinding of rocks together, much as flour is made by grinding wheat; in fact, glacial soil is sometimes called *rock flour*. As the glacier scraped along, it ground an enormous quantity of rock to bits, so that when it melted, a layer of drift (Fig. 18) was left, in some places reaching a depth of several hundred feet. Most of the clays from which bricks are made in the North were also brought by the glacier.

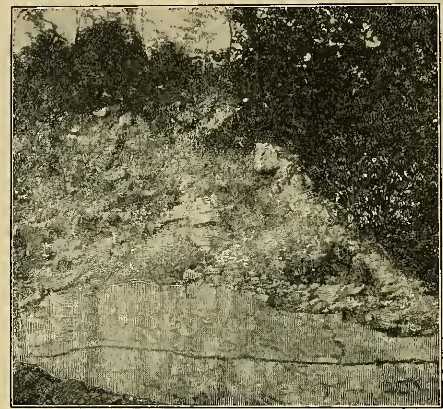


Fig. 18.
Glacial soil resting on the bed rock in Central New York.

With the melting of the glacier, much water was produced. This washed out and carried off a great deal of clay, in some places leaving extensive sand and gravel plains, where the soil is not very fertile. Many of the cities of New England are built upon these level sand plains. Into the sand beds the rain water readily soaks, and then slowly oozes out, thus keeping the streams supplied with water. This makes the sand plains great reservoirs of water, much as lakes are.

Fig. 19.
A field on Cape Ann, Mass., where the glacier left many large boulders.

The bits of ground-up rock left by the glacier have an important effect upon the soil. Since these fragments were gathered up from many places, and from many different kinds of rock, they sometimes cause a fertile soil in places where the decay of the rocks would have naturally caused a sterile soil. The constant rusting or decaying of these rock fragments supplies the soil with plant food; and for this reason the glacial soils are usually fertile year after year. But, on the other hand, in some places the glacier failed to grind the rock into tiny bits, leaving pebbles and even large boulders to cover the ground and prove a great nuisance to the farmer (Fig. 19).

The Coast Line. — In studying about the Mississippi Valley and the formation of coal, we have seen that the land and sea bottom are not fixed, but that they often slowly rise or sink.

Such changes in the land level are even now in progress in many places, though so slowly that it requires years, and even centuries, to notice them. For instance, along the coast of New Jersey the land is sinking at the rate of about two feet a century, while the land around Hudson Bay is rising.

Some of the recent changes in the level of the land have had an important effect upon the coast line. For example, the reason we find so many islands and peninsulas along the northeastern coast (Fig. 95) is that this section has been lowered several hundred feet. By this means the ocean water has been allowed to enter the valleys, while the higher land between them extends above the water in the form of peninsulas, capes, and islands.

The peninsulas of Labrador and Nova Scotia, and the hundreds of islands along the northeastern coast, including Newfoundland, owe their existence to this sinking. The irregular Pacific coast from Puget Sound northward (Fig. 20) was produced in the same way.

By this sinking of the land many good harbors were made, the best ones being where rivers enter the sea.

When the land was higher, the streams carved out broad valleys, into which, when the land sank, the sea water entered, forming bays and harbors. That is the way the Gulf of St. Lawrence was formed; also New York, Delaware, Chesapeake, and San Francisco bays, as well as the many excellent harbors of the East. What rivers carved out the bays mentioned? (See maps, Figs. 95, 97, and 121.)

One reason for so few good harbors along the coast of the Southern States is that the land in this section has been *rising* out of the sea. Just off the coast is a broad

FIG. 20.

A picture of the irregular coast of Southern Alaska, near Sitka, where the sinking of the land has drowned the valleys, leaving only the hilltops projecting above the sea.

ocean-bottom plain where the water is shallow (Figs. 96, 122, and 154), while still farther out, the bottom slopes rapidly and the ocean becomes very deep. Upon this sea-bottom plain, called the *continental shelf*, layers of rock bits, or *sediment*, are being deposited, much as layers of rock were formed on the sea bottom during the coal period. If the continental shelf should be raised it would form a great level plain.

That part of the Southern States which borders the Gulf and the ocean was once a portion of this ocean-bottom plain; but it has been raised until it is now a low, level plain (Fig. 21). Since the continental shelf is so level, when a part of it was lifted above the water there were few places for deep inlets, bays, and harbors. After being raised, the coast was slightly lowered; but the bays thus formed are shallow and the harbors poor.

Fig. 21.

A part of the raised sea bottom which forms the level plain of Florida.

The level plain of the Florida peninsula is also a sea bottom that has been lifted above the ocean. Many of the lakes and swamps which abound in that region are believed to be due to the shallow basins built by the irregular deposit of sediment on the old sea floor.

Size, Shape, and Position. — North America is third in size among the six continents of the earth. By reference to page 445, find which are larger and which smaller.

After being changed in shape during millions of years, owing to the rising and sinking of the land, it at present has the form of a triangle with the broadest portion in the north. Draw the triangle. Compare its shape with that of South America and Africa (Fig. 359). The northern part is so wide that Alaska extends to within fifty miles of Asia; but Labrador is over two thousand miles away from Europe. The distance from Alaska to Asia is so short that the early ancestors of our Indians and Eskimos probably first reached North America by crossing over from

Asia. On account of the greater distance across the Atlantic, for a long time Europeans did not know that North America existed; but it is certain that the Norsemen from Norway visited our shores nearly five hundred years before Columbus discovered the continent.

Those portions of North America which are nearest to Asia and Europe are so cold that few people live there. Farther south, where most of the inhabitants live, the continents are spread farther apart, as you will see by examining a globe. The broad Atlantic must be crossed in passing from Europe to America; this fact helps to explain why the Spanish colonies were able to win their independence from Spain, and the United States from England. The distance across the sea was too great to send large armies and supplies for them.

This separation of Europe from America has also helped in the development of our industries. At first, the colonists brought even bricks, doors, and timber from Europe; but although the ocean is an excellent highway, it is expensive to send goods such long distances. Therefore the settlers soon learned to raise and make most of the articles that they needed for food, clothing, and shelter.

Nevertheless, the ocean is such an excellent highway that ships are able to sail across it in every direction and bring what we really need, or carry back such products as cotton and tobacco, which Europeans desire. Ships have also brought to us the hundreds of thousands of English, Irish, Germans, French, Swedes, and others who have settled and developed our country, and whose descendants are its citizens. Since Europe is our *mother land*, it has been, and is still, very important to keep in close touch with the various nations of that continent. This has been made possible partly by the shortness of the journey, now that vessels are moved by steam, and partly by the excellent harbors caused by the sinking of our coast.

The Pacific Ocean is much wider than the Atlantic (see a globe), and therefore much more difficult to cross. Although the shores of Asia which face North America are densely settled, until recently we have not needed to have much commerce with the inhabitants of that continent because they were not very progressive. Now, however, the Japanese have adopted the methods of modern civilization, and we have come into control of the Philippine Islands, so that many of our ships cross the Pacific.

South America is also easily reached by water, and there is much trade with the various countries of that continent. Although South America is joined to North America by the narrow Isthmus of Panama, there is at present no railway connecting the two continents, though one is being planned. This isthmus is a great barrier to ocean commerce between eastern and western United States and between the Eastern States and Asia. It is very narrow, and in places only two or three hundred feet high; yet, because it is there, ships must travel thousands of miles around South America. A railway crosses it, and ship canals, one across the isthmus and another farther north, are planned. Of what advantage will these be?

Relation of Man to Earth.— So we see that our continent, as we know it, has not been here from the beginning; instead of that, millions of years have been required to prepare it for us. Ocean bottoms have been lifted into mountains, plateaus, and valleys; coal beds, building stones, and valuable minerals have been formed; a mighty glacier has swept over the country, grinding rock into powder and causing lakes, water-routes, falls, and rapids; and the coast has been sinking here and rising there, producing fine harbors in some places and greatly increasing the extent of the plains in others. Our very position, separated by the ocean from the Old World, and yet enabling us to reach it when it is necessary, is an advantage.

But our comfort and prosperity do not depend upon the land alone: the *sun*, the *air*, and the *ocean* are also of great value to us. The sun supplies our *heat;* but it is warmer in *summer* than it is in *winter*. The air, which envelops the earth, is heated by the sun's rays, and moves about, forming *winds*. These bring us vapor from the ocean, and this vapor falls to the earth in the form of *rain* and *snow*. The water of the ocean not only furnishes vapor for rain; it is also disturbed by *waves* and *tides* which do important work along the coast, and by warm and cold *currents*, which affect the climate even hundreds of miles away. All these matters need to be studied before we can fully appreciate how beautifully the world is adapted to our needs.

Review Questions. — (1) What was the condition of North America in early times? (2) What is coal made from? Tell how it was formed. (3) What proofs are there of this formation? (4) What is peat? (5) Name and locate our two chief mountain systems. (6) How high are the plateaus at the base of each? (7) Explain why the plateaus are so level in spite of their height. (8) How have the mountains been made? (9) Explain what effect this has had upon mining. (10) Tell about the volcanoes of the West.

(11) Why is the Mississippi Valley called a trough? (12) What was its condition in early times? (13) How was the interior sea finally changed to dry land? (14) Mention some ways in which the mountains control the Mississippi Valley. (15) What differences would follow if the ranges extended east and west?

(16) Describe the Greenland glacier. (17) How far did the great American ice sheet reach? How deep was it? (18) What are moraines? (19) What do the scratches on the rocks tell us about the glacier? (20) Why is a glacier compared to a plough? A file? A dump cart? (21) In what ways did the glacier cause lakes?

(22) Falls and rapids? (23) Soil? (24) What effect has the glacial soil upon farming? (25) Tell the whole story of the glacier.

(26) Why are there so many islands, peninsulas, bays, and harbors in the northeast? (27) Name some of them. (28) How have some of our largest bays been made? Name them. (29) Why are there so few harbors on our southern coast? (30) What is the cause of the southern plains? (31) What is the continental shelf? (32) How does North America compare in size with the other continents? (33) How far is the mainland from Asia and Europe? (34) Show how our position is a favorable one. (35) What is the influence of the Isthmus of Panama?

Suggestions. — (1) Make a collection of different kinds of coal. (2) Examine some pieces of soft coal closely to see if you can discover plant remains. (3) Obtain some peat. (4) Learn what you can about coal mining. (5) What is the elevation of the land at your home? (6) Examine layers of rock in your neighborhood to see if they are horizontal or tilted. See if they contain fossils. (7) Make a drawing similar to Figure 10. (8) Why are volcanoes shaped like a cone? Why is there a crater in the middle? (9) Make a model of a volcano out of sand or clay. (10) What becomes of the Greenland icebergs? (11) Make a map showing the extent of the American glacier. (12) What signs of the glacier, if any, can you find in your neighborhood? (13) Examine the clay in a brickyard. (14) Pound a pebble to bits and plant beans in it to see if they will grow as well in that as in soil. (15) Name several great cities that have grown up about our Northern harbors. Name some in the South. (16) Draw an outline map of the northeastern coast, and another of the southern coast, to see how they differ. (17) Collect pictures of volcanoes, glaciers, mountains, and plateaus. (18) With the aid of sand in a basin make a model of an irregular land, then pour in water to show how it enters to form bays, islands, etc. (19) How many days long is the voyage, on a fast steamer, from New York to Liverpool? How many miles an hour does the steamer go? How many miles does that make the distance? (20) How long is the journey from San Francisco to Manila? (21) From New York to Manila by going eastward? Through what waters would one pass on such a voyage? (22) What would be the distance from New York to Manila by sailing around South America? How much shorter would it be if the ship could go through a canal across the isthmus?

For References to Books and Articles, see page 438.

II. SUMMER AND WINTER

The Sun and its Position. — The earth is a planet, one of the members of the solar system, all of which revolve around the great central body, the sun. Although millions of miles away, the sun supplies us with light and heat, for it is a glowing hot sphere over a million times as large as the earth (Fig. 22). The rays from the sun pass outward in all directions, and some of them fall upon the earth (Fig. 23), causing the light and heat which are of so much importance to us.

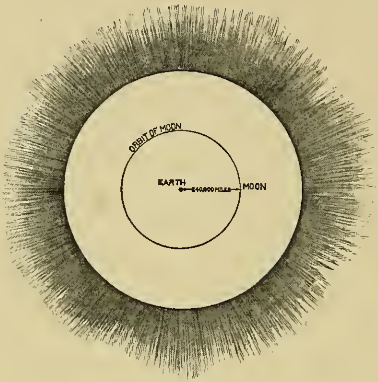


Fig. 22.

Relative size of earth and sun. This shows how very large the sun is. Notice that the distance from the centre of the sun to its outside is much greater than the distance from the earth to the moon, which is 240,000 miles from us.

Light and heat vary greatly in different places. If we could spend a summer north of the Arctic Circle with the Eskimos (Fig. 24), we would find weeks of constant day,[1] and be able to see at midnight as well as at midday. The sun reaches the highest point on the longest day, June 21st, but it is even then low in the heavens (Fig. 32). Day

[1] Exactly at the north pole there are six months of day and six months of night.

after day it circles around the heavens near the horizon, coming nearer the horizon at night than during the day.

Later in the summer, the sun begins to set and the days to grow rapidly shorter. Finally the sun disappears, even at noon, though for several weeks there is twilight in the middle of the day. Soon, however, there is no twilight, and darkness prevails throughout the whole twenty-four hours, accompanied by bitter cold.

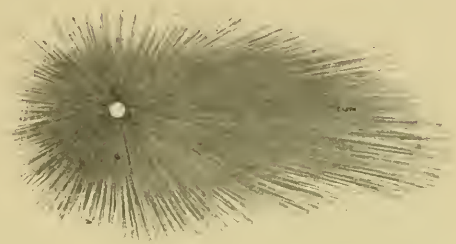


FIG. 23.

Notice that of all the rays passing outward from the sun only a very small part reach the earth, the rest passing off into space.

FIG. 24.

Some of the Eskimos whose homes are in the frigid north. The mothers carry the babies in fur hoods on their backs.

During the winter night the stars and moon furnish a dim light by the aid of which the Eskimos are able to hunt the seal and polar bear which supply them with food. On these hunts they dress in warm furs and travel over the frozen sea on sledges drawn by wolf-like dogs.

In the south frigid zone, the same changes in the sun's position occur, though there the sun is highest on December 21st.

This causes the long summer day to come there while the north frigid zone is wrapped in the darkness of the long winter night.

Now let us fancy ourselves in the torrid zone. There the sun reappears every morning in the year; and every noon it is almost directly overhead, while for a part of the year it is exactly overhead. No snow and ice are seen, and the climate is so warm, even during the winter, that the inhabitants wear as few clothes as possible. Indeed, some savages wear almost none (Fig. 25).

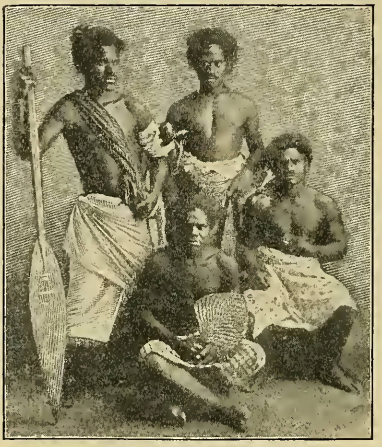


Fig. 25.

Savages whose homes are in the tropical zone. Contrast their dress with that of the Eskimos (Fig. 24).

While the noonday shadows in the north temperate and north frigid zones always fall toward the north, and in the southern zones toward the south, in the torrid zone they fall northward during one part of the year and southward during another part. Of course at the time when the sun is directly overhead they do not extend in either of these directions.

These different positions of the sun, with the resulting changes in the length of the days and in the seasons, are among the most important facts about our home, for they compel great changes in our food, clothing, and habits. What differences, from season to season, are there in the position of the sun and the length of the day where you live? Two causes work together to produce these changes, as we shall now see.

Inclination of the Earth's Axis.—One cause for change of seasons is the position that the earth holds with reference to the sun. It is easy to see that if the earth always stood before the sun, as shown in Figure 33, page 35, the sun's rays would reach from pole to pole, lighting one half of the globe at a time and leaving the other half in darkness. As the earth made its daily rotation, all places upon it would have day and night every twenty-four hours, excepting at the very poles, where the sun would *always* be seen on the horizon.

But if the earth's axis were tipped or *inclined*, so that the north pole was always turned *toward* the sun, as in Figure 31, the conditions would be very different. Then, as the earth rotated, the sun's rays would not only reach the north pole, but extend beyond it, while they would not reach the south pole at all.

In that case, if one stayed a year in the north frigid zone, the sun would be in sight all the time, while if he stayed a year at the south pole he would not see it at any time. Since the sun furnishes heat as well as light, it would always be summer in the northern hemisphere and winter in the southern.

If the earth's axis were tipped so that the south instead of the north pole were the one always turned toward the sun (Fig. 34), the opposite condition would prevail in each hemisphere. That is, it would be perpetual night at the north pole and constant winter where we live; but perpetual summer would prevail in the south temperate zone, and the south pole would have constant sunlight.

The fact is, that *the earth's axis is always inclined*, as in the figures; but, as we well know, our summer does *not* last all the time, nor do we have perpetual winter. We also know that both the north and south poles are in darkness a part of the year, and lighted for the remainder of the year.

Revolution of the Earth around the Sun. — This leads us to the second cause for our seasons. Although the earth's axis is *always* inclined in the same direction, the earth does *not* always remain on the same side of the sun. Therefore it does not have the same pole always turned toward the sunlight; for, in addition to its rotation, the earth has another movement, that of travelling, or *revolving*, around the sun (Fig. 27).

The sun is about ninety-three million miles from us — a distance so great that no one can fully realize it; but the earth is moving at such a tremendous rate that it completes one journey around the sun, or one *revolution*, in almost exactly 365 days, or one year. This explains how we get our year.

In its revolution the earth is moving at the rate of more than one and a half million miles per day. What speed! And at the same time it is whirling or rotating rapidly on its axis, as already explained (see First Book, p. 115).

The Attraction of Gravitation. — As in the case of the earth's rotation, one might ask (First Book, p. 116), Why are we not swept from the earth by the wind? The answer, as before, is that the air, and everything else upon the earth, is drawn toward it and held in place by the force of gravity, so that all travel together in the journey around the sun.

If the earth is revolving at such a fearful speed, why does not the earth itself fly away into space? As a stone swinging round at the end of a string flies off when the string breaks, so it might seem that the earth would fly away, since there *appears* to be nothing holding it to the sun.

But there *is* something to hold it. It is not a string nor a rope, to be sure, but something far stronger. The sun is very much larger than the earth, in fact, over a million times as large, and attracts the earth to it, as the force of gravity attracts men and houses to the earth. This *attraction of gravitation,* which the sun exerts upon the earth, is what prevents the latter from flying far off into space; it holds the earth as firmly as the string holds the stone.

Fig. 26.

Notice that the axis here is inclined in the same direction in each case, but that the light reaches different places on the apple in each of the three positions.

Effect of Inclination and Revolution. — Since the earth's axis is always inclined in one position, the revolution causes first one pole to be turned toward the sun, and then the other. You can understand how this must be if you run a needle or slender stick through an apple, as in Figure 26, and carry it around a lamp which represents the sun. In doing this be sure always to keep the stick, which represents the earth's axis, tilted in the same direction. As you go, the part of the apple turned *toward* the lamp constantly changes. The inclination of the axis does *not* change; but, nevertheless, first one end, or pole of the stick, faces the light, then the other.

So it is with the earth; as it revolves around the sun, always with its axis inclined in the same way (Fig. 27), it is constantly reaching new places in its path of revolu-

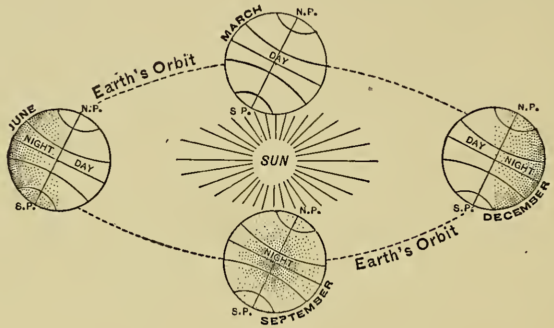


FIG. 27.

To show how the earth appears as it journeys around the sun. In order to represent this clearly, it has been necessary to make the earth appear very much larger than it really is. Compare the size of the earth and sun here with that in Figure 22, where their relative size is shown.

tion, now with the northern hemisphere facing the sun (June, Fig. 27), and the southern hemisphere turned away from it, then, later, with the conditions just reversed.

Summer and Winter.—These changes in the position of the earth with reference to the sun exert an immense influence upon the life on the globe. They cause us, whose homes are in the temperate zone, to struggle at one season to keep cool and at another to keep warm; while for weeks, and even months at a time, they force the Eskimos to hunt their food in darkness and in the midst of the most intense cold (p. 27).

To understand why it is cold in winter, we must remember that our light and heat are received from the sun, and that it

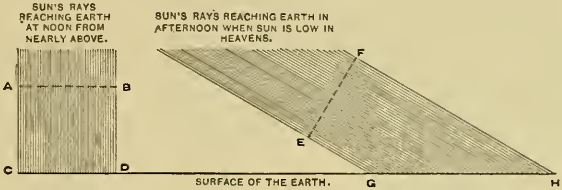


FIG. 28.

Two bundles of rays, each a half inch wide (A–B and E–F); but since one set comes from nearly overhead, while the other set comes at a slant, the first fall upon a smaller surface than the second. If you measure C–D, you will find it half as long as G–H. That is, the same number of rays coming at a slant cover twice as much ground as those from overhead.

makes a great difference how the sun's rays reach us. Morning and evening are cooler than midday chiefly because at the former time the sun's rays fall at a greater slant (Fig. 28); and for the same reason winter is colder than summer.

You have, of course, noticed that in midwinter the sun rises and sets far to the south of the true east and west, and that even at noon it is low in the heavens; but in midsummer it rises and sets much further to the north, and at noon is

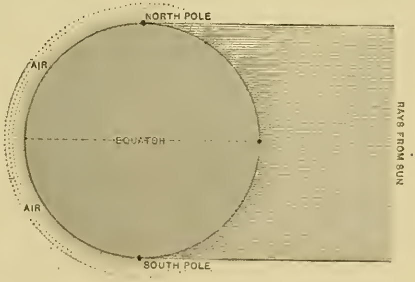


FIG. 29.

A diagram showing that the sun's rays near the poles reach the earth in a more slanting way, and after passing through more air, than at the equator.

far higher in the heavens. When the sun is so low, the rays reach the earth in a slanting way, so that fewer of them fall upon a given area of ground than when they come from nearly overhead (Fig. 28).

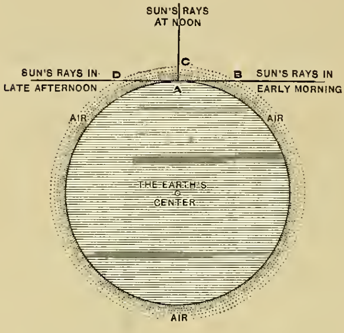


FIG. 30.

To show that the sun's rays pass through more air when the sun is low in the heavens than when it is high. Explain the figure.

There is a great deal of dust floating about in the air, as may easily be seen when a beam of sunlight enters a dark room. This interferes with the passage of the rays, much as muddy water does; hence, when the sun is low and its rays pass through a great thickness of dusty air (Fig. 30), many of them are prevented from reaching the earth. In large cities where there is much smoke, and on hazy days when there is much dust in the air, the sunlight is greatly interfered with.

The Length of Day and Night. — The northern hemisphere faces the sun most fully on the 21st of June, as shown in Fig. 31. At noon of that day the sun is directly over the heads of the people who live in Cuba, southern Mexico, and other places on the *Tropic of Cancer*.

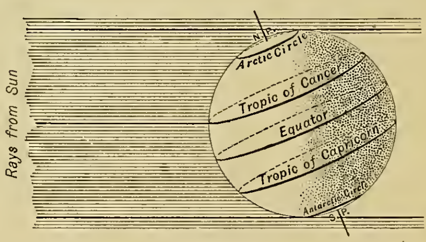


FIG. 31.

Position of the earth June 21. Notice the vertical ray (middle heavy line) over the Tropic of Cancer. The shaded portion of the ball represents night.

At that time there is sunlight throughout the entire twenty-four hours in all the region enclosed by the *Arctic Circle*. Find this upon a globe, and note how much of Greenland and Alaska it includes.

The 21st of June, when the midnight sun shines on all parts of the north frigid zone, is our longest day; but farther south the days grow shorter until the *Antarctic Circle* is reached. There, on June 21, the sun just appears on the horizon at noon, while nearer the south pole it is dark as night throughout the entire twenty-four hours.

Fig. 32.
The sun at midnight of June 21, at North Cape, Norway.

After the 21st of June, the earth's further revolution causes the north pole to begin to turn away from the sun and the south pole to turn toward it. The sun then *appears* to be moving southward; but, as in the case of sunrise and sunset, we know that it is not the sun, but the earth, that is moving.

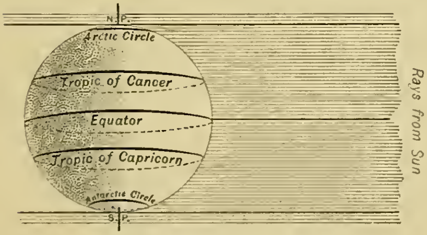


Fig. 33.
Position of the earth September 22.

On the 22d of September, the sun's rays are vertical at the equator, and its light just reaches the poles (Fig. 33). Now that the days are shorter than the nights, our summer is over.

By the 21st of December, the sun's rays are vertical at the *Tropic of Capricorn* (Fig. 34), and they reach far beyond the south pole, lighting and warming all the south frigid zone throughout the entire twenty-four hours. Then the north frigid zone is left in darkness. At that date, which is the beginning of winter with us and of summer in the southern hemisphere, the sun appears farthest south, and we have our shortest day. This is also the day when the sun's rays reach us at the greatest slant.

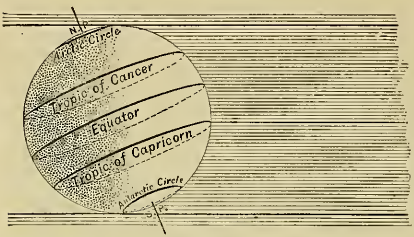


Fig. 34.
Position of the earth December 21.

As the earth revolves farther, the vertical rays of the sun fall farther north, reaching the equator again on March 21, when spring begins (Fig. 35). The 22d of September and the 21st of March are called the *equinoxes* (a word meaning equal nights), because the days and nights are then equal in length.

On June 21, the rays are once more vertical over the *Tropic of Cancer*, and thus a year has been completed. Every year the earth makes this revolution, producing our seasons and constantly changing the length of our days and nights.

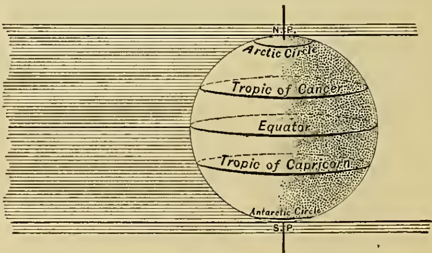


Fig. 35.
Position of the earth March 21.

We see that these important changes are due to the inclination of the earth's axis and to the revolution of the earth around the sun. Can you think what would be the result if the axis were inclined considerably more? Carry an apple around the lamp in this different position to see. What changes would then have to follow in our mode of living? What if the axis were inclined less? What if it required more than 365 days for the earth to revolve around the sun? What if considerably less?

The Zones. — It will be remembered from the First Book (p. 120) that the Tropics and the Arctic and Antarctic circles form the boundaries of the zones; and, from what has just been said, it is evident that it is the sun's position in the heavens that fixes these boundaries. What is the position of the sun at noon of June 21 at the northern boundary of the north temperate zone? At the southern boundary? What is its position on December 21? Answer the same questions for the south temperate zone. For the torrid zone.

You will remember, of course, that there is nothing to mark the position of these boundaries, and that if a person should pass from one zone to another, he would find the change so gradual that he probably would not know when they were passed. Indeed, in some places, the climate is cooler within the torrid zone than it is outside that zone. Suggest some reasons why this is true.

Questions. — (1) What changes in the sun's position are noticed where the Eskimos live? What about the temperature? (2) How do the changes in the south frigid zone differ from these? (3) What conditions prevail in the torrid zone? (4) What changes occur in the temperate zone where you live? (5) In the south temperate zone? (6) In what direction do shadows fall in each of the zones? (7) What would be the effect if the earth's axis were always in the position shown in Figure 33? (8) If the north pole were always turned toward the sun? (9) If the south pole were always turned toward it? (10) What is the real position of the earth's axis? (11) What other motion besides rotation has the earth? (12) What determines the length of a year? (13) Why do we not notice the rapid movement of the earth? (14) What prevents the earth from flying off into space? (15) Show how the revolution of the earth causes first one pole, then the other, to be turned toward the sun. (16) What are the two causes for our changes of seasons? (17) Why are the sun's rays less intense when the sun is low in the heavens than when it is higher? (18) On what day does the sun appear farthest north? (19) What does the Tropic of Cancer mark? The Arctic Circle? (20) When is the longest day at your home? What is the position of the sun then? (21) What about the southern hemisphere at that time? (22) What causes the sun to appear to move south after June 21? (23) When does our autumn begin? Our winter? (24) What does the Tropic of Capricorn mark? The Antarctic Circle? (25) When does our spring begin? Our summer? (26) What are the boundaries of the different zones?

Suggestions. — (1) Show by a globe, or a ball, how the two movements of the earth, rotation and revolution, can be going on at the same time. (2) How cold is it in winter where you live? How warm in summer? (3) How long is your day at present? Are the days growing longer or shorter? (4) During which months do they grow longer? (5) During which months shorter? (6) Measure the length of the shadow of a tall pole at midday, and observe whether it is growing longer or shorter each day. Why is it changing? (7) Make a drawing showing the five zones of the earth and the lines that bound them. (8) Notice the stars, especially those of the Great Dipper, in the fall and again in the winter, to see whether they also appear to change their position. (9) The axis of the earth always points nearly toward the north star. Should you expect that star to move also? Watch to see if it does. (10) What large stars can be seen in summer? In winter? Why different ones? (11) Have you ever seen an eclipse of the moon? What is the cause of one? (12) Write a story telling how the change from summer to winter affects your plays, food, and clothing. (13) Write another story about some changes that you have noticed, in plants and animals, which have been caused by the change in season. (14) Find just how many degrees the axis of the earth is inclined.

For References to Books and Articles, see page 439.

III. WIND AND RAIN

Importance of Winds. — On some days the air seems too lazy to move; it is *calm*, and will neither lift kites, turn windmills, nor push sailing vessels. We have learned (First Book, Chapter VIII) that the air obtains vapor by evaporation of water, and that it takes much vapor from the ocean. We have also learned that the winds may carry this vapor for hundreds of miles before it is condensed into raindrops or snowflakes. If the air did not move, but were always calm, as on some days, there could be no vapor brought to form rain: then the continents would be deserts, and plants, animals, and men could not live upon them.

Winds do blow most of the time in all parts of the world, and they carry with them vapor enough to water most of the land. It will be important, therefore, to study the winds and see what causes them, what their prevailing directions are, and what effect they have upon the climate of different parts of the world.

The Sea Breeze. — The cause of winds is often well illustrated near the seashore. For reasons that cannot be stated here, land warms much more quickly than water. That this is so, you can easily prove for yourself by placing two pans upon a stove, one with a thin layer of dry earth, the other with the same quantity of water, and by noticing which becomes hot first.

On a hot summer morning, the land along the seashore soon becomes warm, and the air above it is heated, as over a stove, so that it expands and grows light. That over the water, remaining cool like the sea itself, pushes in toward the shore; and thus a breeze from the sea, or a *sea breeze*, is created. In summer, such a breeze is frequently felt at the seashore and along the shores of large lakes, and it helps to make the temperature so agreeable that many people resort to those places during warm weather.

At night time, the land cools more rapidly than the sea; and then the cool air from the land moves out toward the sea, forming a *land breeze.*

The Monsoon Winds. — Similar winds blow from the ocean far into some of the continents. In Asia, for example (Fig. 36),

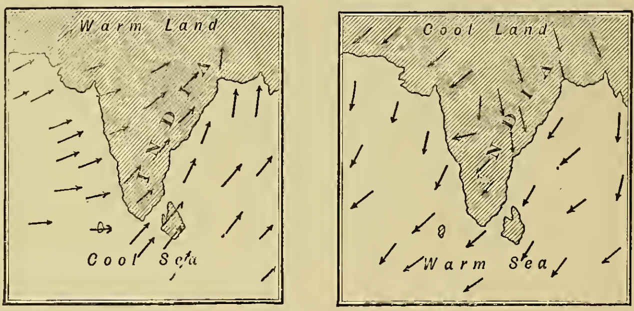


Fig. 36.

The monsoon winds of India, the arrows showing their direction. Which figure represents the summer season? Why do the winds change with the seasons?

where they are best developed, the land becomes so warm in summer that steady winds, called *summer monsoons*, blow from the cool ocean toward the warm land. But during the winter the land is much colder than the ocean, and then the *winter monsoon* blows from the land toward the sea. It is the summer monsoons blowing from the warm Pacific Ocean that cause the heavy summer rains in the Philippine Islands.

These winds are so steady near the coast that the captains of sailing vessels bound for India count upon finding the wind blowing toward the coast in summer and away from it in winter. Summer monsoons also blow from the Gulf of Mexico over the plains of Texas and the lower Mississippi Valley, bringing vapor for rain. Notice on the map (Fig. 46, p. 50) that this is a very rainy region.

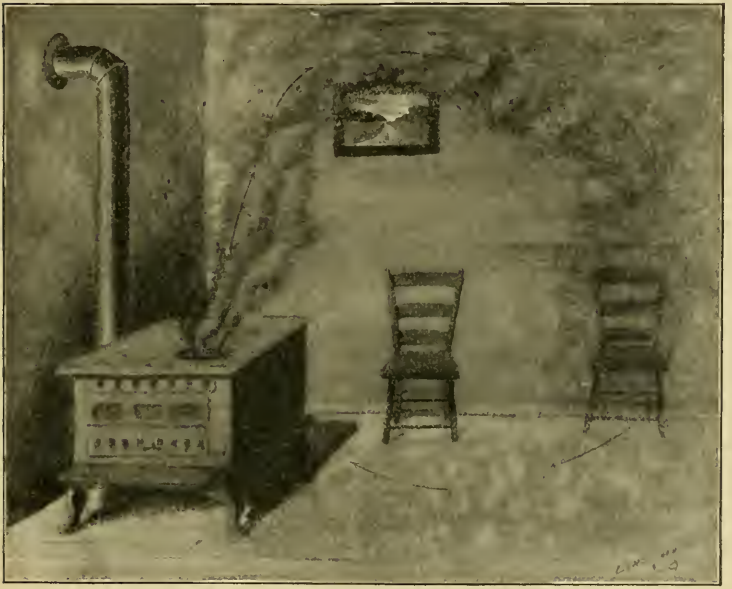


FIG. 37.
To illustrate how the air moves in a room heated by a stove.

The Effect of a Stove. — The difference in temperature of sea and land is not the most important cause of winds. There are other differences in temperature that are much greater; but in order to understand the winds that they produce, let us first consider the currents of air produced by a hot stove in a room (Fig. 37).

As the air near the stove is warmed, it expands and grows lighter. Then the cooler air settles down and flows in, forcing upward that which has been warmed. The latter grows cooler in contact with the cool ceiling and walls of the room; and, being made denser and heavier on that account, it again settles toward the floor and then once more moves toward the stove. In such a room you can easily observe how much warmer the air is near the ceiling, where it has risen from the stove, than near the floor at some distance from the stove.

Cause of the Trade Winds. — The greater winds of the earth may be compared to this movement of air in a room,

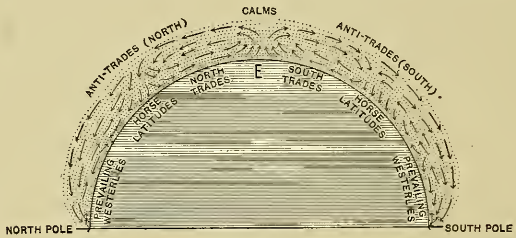


FIG. 38.

Diagram to show, by arrows, the movement of the greater winds of the earth.

the torrid zone, warmed by the sun's rays, taking the place of the stove. There, owing to the torrid heat, the atmosphere becomes expanded and light. The heavier air to the north and south flows in, pushing the light air away and producing winds, known as the *trade winds* (Fig. 38), which begin in the temperate zone, hundreds of miles away.

Since the heated air must escape somewhere, it rises far above the surface, and then moves back in the same direction from which it came, forming the *anti-trade winds* (Fig. 38). The atmosphere extends many miles above the earth, so that there is plenty of room for two winds blowing in opposite directions, one above the other.

In Cuba, the Caribbean Sea, and elsewhere, where the trade winds at the surface are blowing toward the southwest, one notices that the clouds far up in the sky are steadily borne in the opposite direction by the anti-trades. Also, when volcanoes in Central America have been in eruption, the ashes that were blown out from them have been carried hundreds of miles in a direction opposite to that of the prevailing trade winds at the surface.

Being cooled on account of its great height, the air of the anti-trades slowly settles, some of it coming to the surface at about a third of the distance to the poles. There it spreads out, a part continuing on toward the poles, a part returning to the equator as the trade winds (Fig. 38).

As you see, the correspondence between these currents in the atmosphere and those in the room is quite close. In both cases air moves in toward a heated place, then up, then outward and down, and once more inward toward the heated part.

Effect of Rotation. — There are differences, however, and one of them is especially important. In the case of the room, the currents move *directly* toward the stove; then, after rising, directly away from it. If the earth stood perfectly still, the trade winds would doubtless blow directly toward the equator from the north and south (dotted lines, Fig. 39).

The daily rotation of the earth, from west to east, greatly interferes with that movement. Because of rotation, the trade winds are turned, or *deflected*, from their straight course toward the equator. Those from the north are turned to the right, so that they come from the *northeast;* and those from the south are turned toward the left, and therefore come from the *southeast* (Fig. 39).

The direction of the anti-trades is also changed toward the right in the northern hemisphere, where they blow from the southwest, and toward the left in the southern hemisphere, where they blow from the northwest. Thus the anti-trades blow over the same route as the trade winds, but in the opposite direction. We can only state the facts here, for the explanation is far too difficult to give.

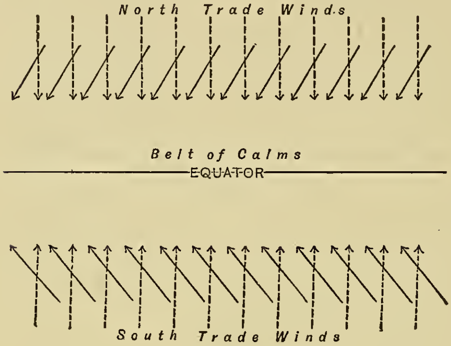


Fig. 39.

The dotted arrows show the direction the trade winds would take if the earth's rotation did not deflect them to the left in the southern hemisphere and to the right in the northern. By deflection they are turned as indicated by the other arrows.

Since the sun, which is the cause of the different zones of heat, has shone for millions of years, and will probably continue to shine for millions more, we may be certain that these great winds are *permanent winds*. The currents of air in a room cease when the stove grows cold ; but, for ages to come, the sun will heat the torrid zone more than the temperate. Thus the trade winds will be kept in motion day and night, winter and summer, as they now are, and as they were when they helped Columbus on his venturesome voyage across the Atlantic.

Effect of Revolution. — The belt of most intense heat is not always in exactly the same part of the earth, being north of the equator in June, when the sun is vertical at the Tropic of Cancer, and south of it in December, when the sun's rays are vertical at the Tropic of Capricorn. This causes the trade and anti-trade winds to change their position somewhat, being farther north in summer than in winter (Figs. 40 and 42). So here is another important effect of revolution; for by it, in many places, the trade winds are caused to blow during a part of the year while they are absent during the remainder.

The Belt of Calms. — At the place where the air of the trades *rises*, that is, moves upward instead of along the surface, the winds are weak and irregular, often dying down to a calm. This is called the *belt of calms* (Fig. 38), or the doldrums. Over this belt, which is several hundred miles in width, the air grows cool as it rises, and the vapor which it carries is condensed, forming clouds and rain.

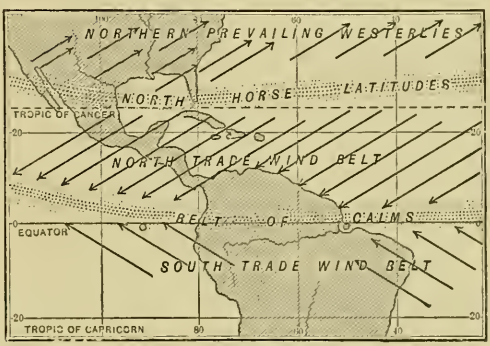


FIG. 40.

Diagram to show the position of the belt of calms and the trade winds in winter. Compare with Figure 42.

For these reasons the doldrums form a very rainy belt extending entirely around the earth (Fig. 44). Clouds begin to form there nearly every morning; and by afternoon, when earth and air have become much heated, the air rises more actively, and heavy showers occur, often accompanied by fierce thunder and lightning.

The rainy belt of calms is of course always in the torrid zone, and usually not far from the middle of it (Figs. 40 and 42). It is the heavy rain there that supplies the dampness necessary for the dense jungles of the tropical forests of the Amazon valley, Central Africa, and the East Indies.

This is one of the rainiest regions in the world; but the belt of calms is not always in the same position, moving northward

FIG. 41.

A scene in the dense tropical forest of the belt of calms.

in summer and southward in winter (Figs. 40 and 42). As a result of this, places having heavy rains in one season, when the belt of calms has moved to them, have much less rain in the opposite season. This is very well illustrated in northern Africa, between the Sahara desert and the Sudan, where there is plenty of rain in summer and very little in winter.

The Trade Wind Belt. — In blowing over the ocean, the trade winds obtain a great deal of vapor ; and, as we have seen, some of this is condensed to form rain in the belt of calms. But some of it falls as rain before reaching that belt.

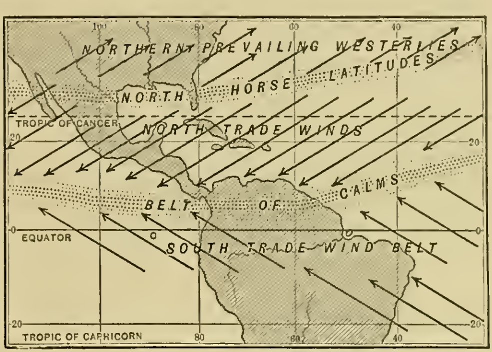


Fig. 42.

Diagram to show the position of the trade wind belts and the belt of calms in summer. Compare with Figure 40.

Notice in Figure 44 that much more rain falls on the eastern side of South America than on the western side. Notice also that south of the equator the trade winds blow from the southeast, while north of it they blow from the northeast. This causes them to reach South America after having passed over the Atlantic Ocean. Therefore the winds arrive on the eastern coast charged with vapor ; then, as they rise over the land and become cooler, some of the vapor condenses to form rain.

From this it is evident that there is a very rainy region not only in the belt of calms, but also in those places, just north and south of it, where the trade winds blow from the ocean upon the land.

After having passed over the land, the air of the trade winds is often so dry that deserts are caused (Fig. 43). In the First Book (p. 249), it was stated that the winds of Australia, which lies in the south trade wind belt, are robbed of their moisture by the highlands near the eastern coast. Thus the interior of Australia is a desert. There are also heavy rains in the trade wind belt on the eastern side of the Andes, while the western side, in Peru and Chile, is arid, although very near the ocean.

Fig. 43.

Picture of a desert. Notice the absence of trees. Contrast this with Figure 41.

In North America much the same thing is seen; for, while the eastern coast of southern Mexico has plenty of rain, central and western Mexico are arid, and in parts

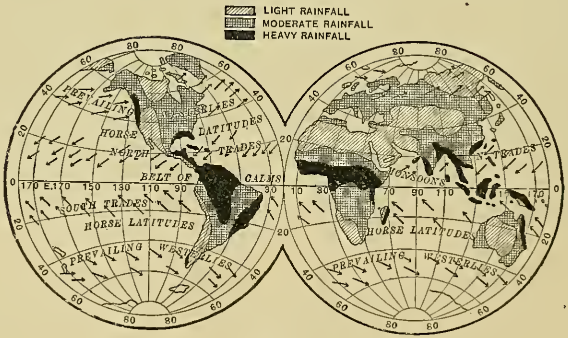


Fig. 44.

A small map of the world to show the regions of heavy, moderate, and light rainfall. The arrows show the direction of the prevailing winds.

almost a desert. The desert of Sahara is also in the trade wind belt, but the winds reach it only from the land.

We have said that both the trade wind belts and the belt of calms change their position somewhat with the season. This of course also changes the rainy belts each season. Therefore in parts of the torrid zone people speak of the rainy and dry seasons much as we do of the summer and winter.

The Horse Latitudes. — It was said (p. 43) that a *part* of the air of the anti-trades settles to the earth and returns as trade winds toward the belt of calms (Fig. 38). At this place there is a belt of light, variable winds with frequent calms, because the air is coming down instead of moving along the surface. This belt is known as the *horse latitudes*.[1]

While rising air becomes cool, thus causing clouds and rain, air that is settling and becoming warmer is dry and clear. Therefore in the horse latitudes there is little rain; indeed, there are numerous arid sections in this belt also, as the dry plateau of Spain, and the great deserts of central Asia.

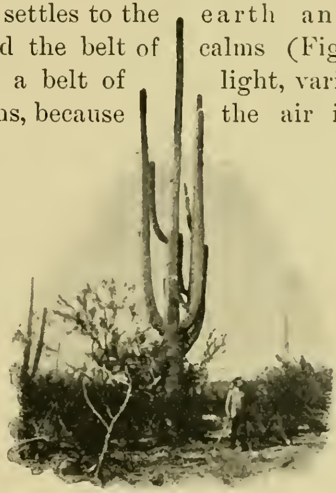


FIG. 45.

A giant cactus, on the desert of southern Arizona, in the horse latitudes.

The horse latitude belt extends across southern United States (Fig. 46), and this is one of the principal reasons for the dry plains of western Texas, and the arid regions of New Mexico, Arizona (Fig. 45), and southern California. Florida and the coast of the Gulf of Mexico are in the same belt;

[1] Called horse latitudes because sailing vessels, carrying horses from New England to the West Indies in the early days, were so delayed by the calms that the horses had to be thrown overboard when the drinking water gave out.

but they are so near the ocean that sea breezes and monsoon winds bring an abundance of rain to them.

The Prevailing Westerlies. — Not all the air of the anti-trades settles in the horse latitudes; some moves on toward

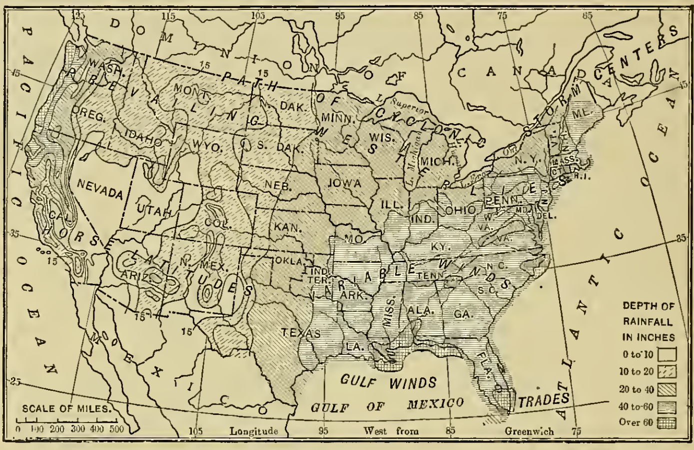


FIG. 46.

A map to show the rainfall of the United States in inches; that is, the number of inches of water that would collect all over the surface in a year if all the rain remained where it fell.

the poles (Fig. 38). If you watch the higher clouds, you will find that they are moving from the west toward the east. In northern United States the winds at the surface are also more often from the west than from any other quarter. This belt, in which the prevailing winds are from the west, is known as the region of *prevailing westerlies.* Northern United States and Canada are included in it (Figs. 44 and 46). Keep a record of the direction of the winds for each day during a month.

Winds are much more steady on the ocean than on the land for several reasons, the principal one being that the temperature of the water does not change so quickly as that of the land. On land one place may become much warmer than another not far away, and then winds blow toward the warmer section. This often changes the direction of the regular winds.

Fig. 47.

Two of the giant trees of the warm, rainy belt of northern California. Notice how small the man appears at the base of the first tree.

So steady are the prevailing westerlies over the ocean, that, in the southern hemisphere, where there is little land, they almost always blow from the west. Indeed, it is said that vessels, choosing a course south of Africa and South America, can sail around the world with fair winds almost all the way, if they go *toward* the east; but if they sail in the opposite direction, the winds are against them.

In the prevailing westerly belt, we would naturally expect a heavy rainfall on the west coasts, as we do on the east coasts in the trade wind belt. The map (Fig. 46) shows that this is so in the United States; and if Figure 44 were large enough it would show it for other sections of the world. For instance, south of the desert country of Peru and northern Chile, on the west coast of South America, there is an abundance of rain.

North of the arid country of Mexico and southern California

(Fig. 46) there is heavy rainfall from northern California to southern Alaska. It is in this rainy belt that the largest trees in the world are found (Fig. 47).

Depositing so much of their vapor on the mountainous land near the coast, these winds soon become too dry to produce much rain. It is for this reason that the plains and plateaus of Idaho, Montana, western Dakota, and other states of the northwest, are for the most part too arid for agriculture without irrigation.

Eastern United States and Canada. — One might expect that the west winds, so dry after passing over the mountains of the Western States, would continue on to the northeastern states and cause them to be arid also; but we know that this is not the case. It is true that the *west* winds rarely bring rain; but, in addition to them, there are east and south winds blowing from the Atlantic Ocean and the Gulf of Mexico, and these bring an abundance of vapor.

In northern and eastern United States the winds are variable, and the temperature is very changeable. In any particular locality on one day it may be warm and pleasant, with a south wind; the next day a cool, dry wind blows from the northwest; after two or three days this gives place to a cloudy sky and rain, brought on by south or east winds; and then fair, cool weather sets in, with the wind again from the northwest.

There are, of course, reasons for these frequent changes, and in order to understand them, let us follow the weather changes for a few days. Out in the northwest there comes to be a place, or an *area*, of *low pressure* (Fig. 49); that is, an area where the air is lighter than that over the surrounding region.

The air from the surrounding country, where the pressure is greater, hurries toward the low pressure area, even from hundreds of miles away, causing winds which on the south side blow from the south, on the east side from the east, and so forth (Fig. 49).

Toward the place where the pressure is low, the air is flowing in from all sides, then rising. As it rises, the vapor condenses, forming clouds and rain, as in the belt

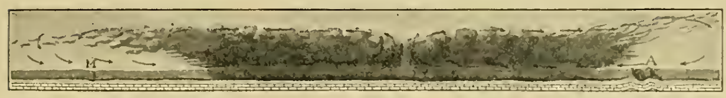


Fig. 48.

A section through a cyclonic storm to show the immense area of clouds and rain. A, represents the Appalachian Mountains; M, the Mississippi River. The direction of the winds is shown by the arrows.

of calms. Such an area of low pressure, with its clouds and rain, is known as a *cyclonic storm area* (Fig. 48), and it is during these storms that most of the rain of northeastern United States and Canada comes.

Instead of remaining in one place, the cyclonic storms steadily travel onward, usually beginning in the northwest and *always* passing eastward (Fig. 50). The paths followed by the storm centres generally pass over the Great Lakes, down the St. Lawrence Valley to the ocean, which they often cross, and reach even far into Eurasia. They move eastward because the prevailing westerlies carry them along: indeed, these great, whirling, cyclonic storms are apparently eddies in the prevailing westerlies, similar to the eddies in the current of a stream.

The area of country upon which rain may be falling from the clouds of one of these storms is sometimes very great, places fully a thousand miles apart sometimes receiv-

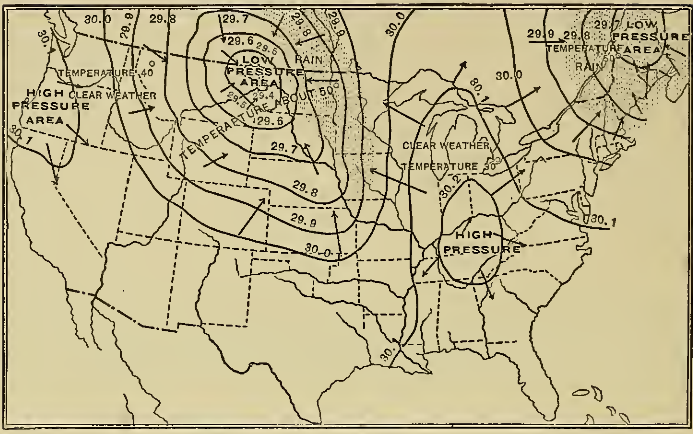


Fig. 49.

A weather map of the United States on a winter's day. The lines are lines of equal air pressure, — the lower the figure, the lighter the air (29.5 representing lighter air than 29.7). The pressure is determined by an instrument called the barometer. Study this map carefully and tell about the air pressure, winds, temperature, and rain in different parts.

ing rain at the same time (Fig. 48). As the storm moves eastward, it grows clear on the western side, while the cloudy and rainy parts appear farther and farther eastward (Figs. 49 and 50).

The vapor is brought toward the storm centre from the Gulf and the Atlantic Ocean, being carried by the winds for hundreds of miles, even into Canada. As stated on page 11, the fact that there is no high mountain range extending across southern United States is of great importance. If there were such mountains, instead of the low Appalachians and the open plains of the Mississippi Valley, the winds could not carry their vapor so far, but would drop it on the coast side, leaving the interior a desert.

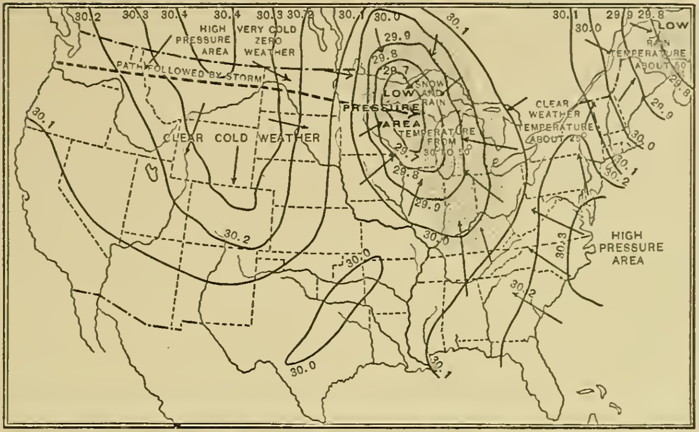


FIG. 50.

Weather map for the day following that of Figure 49. Study this carefully, and tell how it differs from Figure 49.

Not only are rains caused by these storms, but hot spells and other changes as well. Warm winds, blowing toward the low pressure areas from the south, are the cause of the winter thaws and the summer hot spells in the Eastern States. It is during these hot spells that thunder storms come; also, in some places, *tornadoes* (Fig. 51), often called "cyclones," in which the winds blow so fiercely that trees are overturned and houses torn to pieces.

FIG. 51.

Picture of a tornado in Illinois that did great damage because of the fierce winds which accompanied it.

After a low pressure area has passed eastward and the storm is over, the wind generally blows from the west. This causes cool, dry weather in summer, and cold snaps in winter.

Then it is said that a *cold wave* has come; and this, sweeping over the East, and even far into the South, often does great damage to fruit trees and other delicate plants.

Weather Maps. — Figure 49 shows a cyclonic storm in the northwest, the arrows indicating how the winds blow in from all sides toward the centre of low pressure. Farther east is a region of high pressure. In Figure 50, the high and low pressure areas are again represented; but, since it is a day later, they have moved eastward; and the following day they would be still farther east. You see from these maps how the direction of the wind for any one locality has changed as the low pressure areas have passed over the country.

Although the cause of these storms is not yet fully understood, they are so regular, and their importance is so great, that the United States government has established a *Weather Bureau* which employs a large force of men, stationed in different parts of the country, to observe the pressure of air, direction of wind, etc., and to telegraph the facts to Washington. These observations, made at the same time at all stations, furnish information which enables men to foretell the weather. Their predictions are greatly aided by the fact that all of the storms and high pressure areas will move eastward.

Maps, similar to those of Figures 49 and 50, called *weather maps*, are also sent out. By the predictions of the Weather Bureau, farmers and gardeners are warned against damaging frosts, and sailors against severe storms. Hundreds of thousands of dollars are saved in this way nearly every year.

Especially valuable service has been rendered by the Weather Bureau in predicting the very fierce *hurricanes* that arise in the West Indies and sometimes do great damage there, as well as on our own coast. These resemble the cyclonic storms, but are much more destructive.

Since the storms and high pressure areas have so great an influence on our weather, you will find it of interest to study the weather yourself. Watch the changes in wind, temperature, clouds, and rain; and if there is a barometer at hand, observe how it changes as the high and low pressure areas come and go. A great aid to such a study will be found in the weather maps, on which are printed full information about the weather each day and predictions for the next day. See how nearly correct these predictions are.

Questions. — (1) In what ways are winds important? (2) Explain the sea breeze. (3) How are monsoons caused? (4) Where are they found? (5) Describe the circulation of the air in a room heated by a stove. (6) What is the cause of the trade winds? (7) Of the anti-trades? (8) What proofs have we that the anti-trades blow steadily? (9) What becomes of the air of the anti-trades? (10) Compare this circulation to that of air in a room. (11) What effect has rotation on the direction of these winds? (12) Why may we feel certain that these winds are permanent? (13) What effect has revolution of the earth upon the position of the trade wind belts? (14) Describe the conditions in the belt of calms. (15) What effect has the change of seasons upon the position of this belt? (16) What about the rainfall of eastern coasts in the trade wind belt? (17) Of western coasts? (18) In what way do the trade winds help to cause deserts? (19) What influence upon rainfall has the change of the trade winds with the season? (20) What are the horse latitudes? (21) What about the rainfall there? Why? (22) Name some desert sections in that belt. (23) What are the prevailing westerlies? (24) Are they best developed on the land or the water? Why? (25) In the southern or northern hemisphere? Why? (26) What effect have the prevailing westerlies upon rainfall? Give examples. (27) What is the cause of the dry plains of the northwest? (28) Which winds are dry in northeastern United States? Why? (29) Which winds bring vapor? Why? (30) Mention several changes of weather that may often be noticed within a few days. (31) Tell some that you have recently noticed yourself. (32) What happens when there is a low pressure area surrounded by higher pressure? (33) What is a cyclonic storm? Of what importance are such storms? (34) Tell about their movement. (35) Tell about the rain. Whence does it come? Over how much country does it fall? (36) What changes in temperature occur? (37) Explain the two maps (Figs. 49 and 50). How are they different? How alike? (38) What are the duties of the Weather Bureau? (39) What are weather maps? (40) Of what value is the work of the Weather Bureau?

Suggestions. — (1) Estimate the number of barrels of water that falls on an acre of ground, or upon a city block, in one year, where the rainfall is forty inches. (2) How is a movement of air secured in your schoolroom in order to ventilate it? (3) Show on a map or globe where the trade wind belt is on the Atlantic; the belt of calms; the horse latitudes; the prevailing westerlies. (4) Inquire of some one who has been in the torrid zone about the winds and rains there. (5) Do the same for Arizona and southern California. (6) If you live in the northeastern states, watch how the winds blow before and after a storm. (7) Examine a map sent out by the Weather Bureau. Perhaps your teacher can have them sent regularly by writing to the Weather Bureau at Washington. (8) Keep records of the weather. (9) Find a barometer and notice how it changes from day to day. (10) Write a description of a tornado from an account in the newspaper. (11) Read once more the section on "Air" in the First Book, page 71. (12) Write an account of the change in the weather for five days in succession: — the wind direction and force; the clouds; rain; temperature; and, if possible, the air pressure.

For References, see page 439.

IV. OCEAN MOVEMENTS AND DISTRIBUTION OF TEMPERATURE

Like the air, the ocean water is in motion, its three principal movements being wind waves, tides, and ocean currents.

Wind Waves

Waves are formed by winds which blow over the surface of the water and ruffle it, sometimes, during storms, causing it to rise and fall from twenty to forty feet.

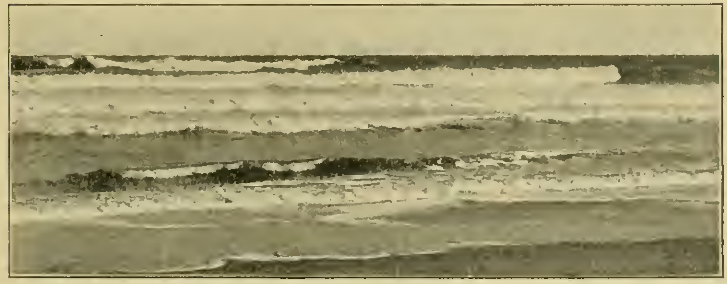


Fig. 52.

Surf on the New Jersey coast, caused by the breaking of the waves as they approach the beach.

In the open ocean, waves are rarely very dangerous to large vessels; but upon the seashore, they do great damage to vessels and even to the coast itself, wearing away the rocks and dragging the fragments out to sea. The constant beating of the waves (Fig. 52) is slowly eating the coast away.

Tides

What the Tides are. — People living upon the seacoast are familiar with the fact that the ocean water rises for about six hours and then slowly falls. This rising and falling of the water twice each day forms what is known as the tide. For a long time it puzzled men to explain this: it was called the breathing of the earth, and by certain uncivilized races it is to this day thought to be caused by some great animal.

Fig. 53.
High tide on a part of the New England coast.

As a result of careful study, we have learned that the tides are caused by the moon and the sun, especially the former. Each of these bodies is pulling upon the earth, by the attraction of gravitation, as a horseshoe magnet pulls upon a piece of iron. When the sun and moon pull upon the earth, the ocean, being a liquid that can be moved, is drawn slightly out of shape. This causes two great

Fig. 54.
The same region as Figure 53 at low tide. Compare the two figures.

swells, or waves (Fig. 55), many hundreds of miles broad, which pass around the earth, following the moon. When

FIG. 55.

A diagram to show how the moon pulls upon the earth and causes the tide waves. Of course their height is not so great as the diagram suggests.

these swells reach the shores, they cause the rise of water known as the tide.

Height of the Tidal Wave. — The tidal wave is only two or three feet high upon headlands which project into the open ocean; but it rises a great deal higher in many bays. There the wave is raised higher because the space that it occupies becomes narrower near the head of the bay. In some such places, as in the Bay of Fundy, the tide reaches a height of forty or fifty feet.

FIG. 56.

Position of earth, moon, and sun at new moon, when *spring* tides are caused by sun and moon pulling together.

The height of the tide also varies from day to day, for the moon and sun, which combine to form it, do not always work together. At new moon and full moon, when the earth, moon, and sun are nearly in one line (Fig. 56), the moon and sun pull together and make the tidal wave higher

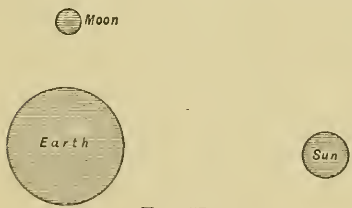


FIG. 57.

Earth, sun, and moon at the quarter of the moon, when sun and moon do not pull together.

than at the quarter, when the moon is forming a tidal wave in one place and the sun in another (Fig. 57). The high range of tides at full and new moon are called *spring* tides, those at the quarters, *neap* tides.

Effects of Tides. — In the open ocean the tides are of no importance, and a sailor might spend weeks at sea without ever knowing that there were tides. But along the coast, where the water rises and falls against the beaches and cliffs, the tides are very noticeable (Figs. 53, 54) and important.

Fig. 58.

Sandy Hook, on the south side of New York Bay, built of sand driven along by the waves and tidal currents, and then piled into sand dunes by the wind.

Where the coast is irregular, the tide is often changed to a *current*, which sometimes moves so rapidly that a sailing vessel cannot make headway against it, but must wait until the tide changes. Such a rapid current is found in one of the entrances to New York harbor, at what is known as Hell Gate, where the channel is narrow and rocky.

These tidal currents, moving in one direction during the incoming or *flood* tide, and in the opposite direction during the outgoing or *ebb* tide, not only aid ships which are going with them, and retard those going against them, but they sometimes drift vessels out of their course and place them in dangerous positions. Many a ship has been lost by being wrecked upon a coast where it was drifted by the tidal currents.

Another effect of the tidal currents is upon the harbors. These currents often carry sand hither and thither (Fig. 58), and build bars opposite the mouths of harbors. This is one of the reasons why the harbors of our Southern States are no better (p. 20). In order to prevent some of them from being entirely shut in by bars, the government is obliged to spend large sums of money every year in order to remove the sand brought by the tidal currents.

Ocean Currents

Cause of Ocean Currents. — The winds which blow over the ocean, forming waves, also drive the water before them. You may do this in a small way by blowing on the surface of a pail of water. This starts a current, or *drift*, of surface water in the direction that the air is moving. Where the winds are steady, as in the trade wind belts, or moderately steady, as in the prevailing westerlies, there is a permanent drift of water, pushed along by the prevailing winds. These form the great system of ocean currents (Fig. 59) which have such an important influence on the earth.

Differences of temperature are also a cause of some movement, as in the case of the air. But since the sunlight cannot reach to the bottom of the ocean, the water there is not warmed, as the lower layers of the air are. Therefore a circulation exactly like that of the atmosphere is not found in the ocean. There is, however, a slow settling of cold water in the frigid zones, a movement along the ocean bottom, and a very slow rising in the torrid belt. While this movement is so slight that it can scarcely be noticed, it is because of this drift of water that the temperature of the ocean bottom is so low. Even at the equator, the temperature of the ocean bottom is nearly at the freezing point.

The North Atlantic Eddy. — Let us now study the main ocean currents on each side of North America (Fig. 59).

In that part of the Atlantic where the trade winds blow (Fig. 44, p. 48), the surface water drifts slowly in the direction of the trade winds; that is, toward the belt of calms. It then moves westward, as a great *equatorial drift*, until the easternmost extremity of South America interferes with its course. There the drift of water is divided, a part being turned southward, while the greater portion proceeds northwestward.

The part which flows northward is deflected toward the right by the effect of rotation, as the winds are (p. 43); and the part which flows into the South Atlantic is turned to the left, also by the effect of rotation. Therefore, the northern drift, instead of coming near to the mainland of North America, keeps turning to the right, crossing the Atlantic to Europe. It then passes southward, and finally returns to the trade wind belt where it started, having made a complete circuit.

Coming from the equatorial region, this water is warm, and in it live countless millions of animals and floating plants. Among the latter, one of the most abundant is a seaweed, called *Sargassum*, which is thrown into the middle of this great eddy. There it has collected until it now forms a "grassy" or "*Sargasso*" *sea* hundreds of miles in extent. Since the "Sargasso" Sea lies directly between Spain and the West Indies, Columbus was obliged to cross it on his first voyage of discovery; and his sailors, upon entering it, were much alarmed lest they might run aground, or become so entangled in the weed that they could not escape.

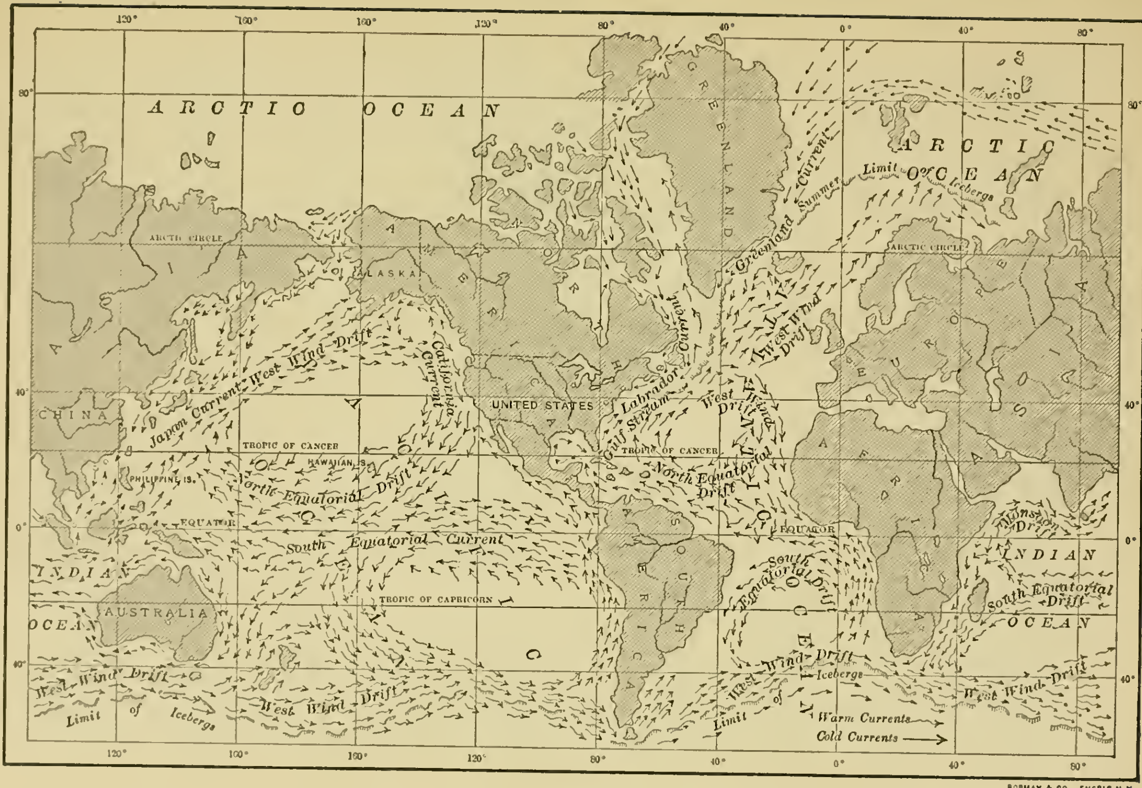


FIG. 59.

A chart showing the principal ocean currents and ocean drifts of the world. Compare their direction with that of the winds on Figure 44, page 48. Study this map carefully. Make a sketch map somewhat like it.

As the drift of warm water eddies round toward the European coast, it carries some of the warmth of the torrid zone to that continent. This is one of the reasons why the climate of northern Spain is warmer than places in the United States at the same distance from the equator.

The Gulf Stream. — A portion of the drift of water which moves northward along the northern coast of South America enters the Caribbean Sea and then passes into the Gulf of Mexico. This is a broad, deep, gently flowing current; and it is so nearly surrounded by the warm tropical lands that it grows even warmer than when it entered the Caribbean. After swirling round the Gulf of Mexico, it escapes between Cuba and Florida, after which it is known as the *Gulf Stream* (Fig. 59) because it comes from the *Gulf* of Mexico. Being forced to pass out through so narrow an opening, its rate of movement is much increased — even to four or five miles per hour — as water in a hose is made to increase its speed by passing through the nozzle. Measure the distance from Key West to Havana (Fig. 95).

Being turned to the right by the effect of the earth's rotation, the Gulf Stream soon leaves the American coast and flows northeastward toward northern Europe. It broadens rapidly and joins forces with the western part of the great Atlantic eddy. In crossing the Atlantic, the drift is pushed along by the prevailing westerlies, so that it reaches the shores of northern Europe, and even enters the Arctic Ocean. Some idea of its size may be gained from the fact that it carries many times as much water as all the rivers of the world.

The Labrador Current. — After being cooled, some of this water settles to the bottom and finds its way back to the torrid zone in the slow drift of cold water which is forever moving along the ocean bottom from the frigid zone toward the equator (p. 63). But much of it returns at the surface, for there is a cold surface current, called the *Labrador current*, passing southward along our northeastern coast (Fig. 59).

The Labrador current flows down from among the islands of North America, past the coast of Labrador, Newfoundland, Nova Scotia, and New England. Like all ocean currents in the northern hemisphere, it is turned toward the right, that is, since it flows southward, toward the west. This causes it to follow our coast very closely, keeping nearer our shore than the Gulf Stream does.

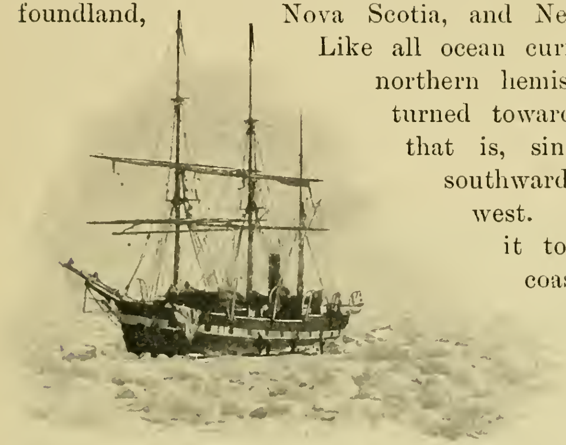


Fig. 60.

An Arctic whaling steamer imprisoned, off the coast of Baffin Land, in the floe ice which is being carried southward in the Labrador current.

Since there are two currents near together, a cold one from the north, and a warm one from the south, a vessel sailing from Boston to England must cross both. During winter storms a ship often becomes covered with snow and ice while in the cold Labrador current, but loses this coating soon after entering the Gulf Stream.

Where the cold and warm currents come near together, a dense fog is produced. You can doubtless explain why that is so (see First Book, p. 77). Sailors who cross the Atlantic have learned to expect heavy fogs as they pass near the coast of

Nova Scotia and Newfoundland, which is one of the foggiest regions in the world.

The Currents in the Pacific Ocean. — In the Pacific Ocean, as in the Atlantic (Fig. 59), the water drifts westward in the belt of calms; then a broad, warm current swings to the right past Japan, crossing the ocean toward Alaska, as the Gulf Stream crosses the Atlantic toward Europe. This, called the Japanese current, carries much warmth from the torrid zone to the North Pacific, as the Gulf Stream does to the North Atlantic. Continuing to turn to the right, this current passes southward to complete the great eddy. There is another eddy in the South Pacific, similar to that in the South Atlantic.

We see from what has been said, that, although the Gulf Stream flows past the Southern States, the northeastern coast of North America is bathed by an ocean current from the cold north. On the other hand, the northwestern coasts of Europe and North America are approached by warm currents from the south. That is, because of the earth's rotation, the warmer water is swung to the western coasts of the continents rather than to the eastern.

The Importance of these Currents. — The facts just stated are of great importance to us. Since the Gulf Stream crosses the Atlantic in a northeasterly direction, it hinders the passage of vessels bound westward, or *against* its current. Benjamin Franklin noticed this effect of the current when he was Postmaster General of the American Colonies shortly before the Revolutionary War. He arranged for the carrying of the mails by ship between England and America, and one fact that he observed was that vessels went to Europe in less time than they returned. After studying the matter carefully, he decided that the Gulf Stream drift was the cause.

While this ocean drift is a hindrance to vessels sailing against its current, it is in other respects of great service. From its warm waters the air obtains much vapor, which falls as rain in the United States and Europe; and in its warm current a vast amount of heat is carried northward. When Nansen started on his famous journey toward the north pole, he entered the Arctic Ocean with this current. Thus, since its warm water keeps that part of the Arctic free from ice in summer, he was able to proceed much farther than he otherwise could have gone.

Fig. 61.
Icebergs that have broken off from the Greenland glacier.

The Labrador current flows as far south as Cape Cod, so that the water north of this promontory must be cooler than that south of it. As the cold current leaves the Arctic region, it bears with it much sea ice which has been frozen during the preceding winters (Fig. 60), and also gigantic icebergs which have broken off from the Greenland glacier (Fig. 61). It is upon this drifting ice that the polar bear spends much of his time hunting for seals which live in great numbers in the ice-covered waters (Fig. 62).

The icebergs may be carried southward one or two thousand miles before the air and water melt them away (see limit of icebergs on Fig. 59). Indeed, some icebergs float even as far south as the paths followed by vessels which cross the Atlantic. Since many bergs are larger than the greatest building in the world, collision with one means shipwreck; therefore sailors need to use great caution, especially when the ship is in the fog.

Fig. 62.

Polar bear and seal on the floe ice of the Labrador current.

The cold Labrador current affects the temperature upon the land. Winds blowing over it carry the chill far inland. This is one of the reasons why the east winds of New England are so cool and why the New England coast is such an agreeable summer resort.

The warm Japanese current of the Pacific Ocean renders the southern part of Alaska far warmer than southern Labrador, which is farther south; and the prevailing westerlies bring an abundance of vapor to the Pacific coast all the way from California to Alaska. Where these winds blow, the winters are mild and the rain heavy; but the summers are cool and pleasant, because the ocean water, though warm, does not become greatly heated. Notice on a globe that the state of Washington, with its pleasant climate, is about the same distance from the equator as the bleak island of Newfoundland, whose shores are bathed by the cold Labrador current.

The world, as a whole, as well as certain small sections, is greatly influenced by these ocean currents. It has been estimated that the Gulf Stream drift carries one-half as much heat into the Arctic as reaches it from the direct rays of the sun. In this way a great deal of northern country, which would otherwise be scarcely habitable, is made to support vast numbers of people. Notice on a map how many large cities are in that part of northern Europe which is the same distance from the equator as desolate Labrador.

Besides thus influencing many parts of the earth, the warm currents have helped to form a great number of islands. Where warm currents flow, the water is often warm enough for corals to live; and, since the moving water brings to them an abundance of tiny animals for food, colonies of corals flourish, and their skeletons gradually form reefs. In this way the southern half of Florida, the Bahamas, the Bermudas, and many of the islands in the South Pacific were built.

Distribution of Temperature

In general, it is true that the farther north we travel from the equator, the colder it grows; but this is by no means always the case. If the earth were made of one solid, level substance, like glass, the temperature *would* gradually decrease from the equator to the poles. Then all points the same distance from the equator, as all on the Tropic of Cancer, or all on the Arctic Circle, for instance, would have the same temperature.

But we have seen that there are several causes which interfere with this regular decrease in temperature toward the poles. For example, high mountains have a cold cli-

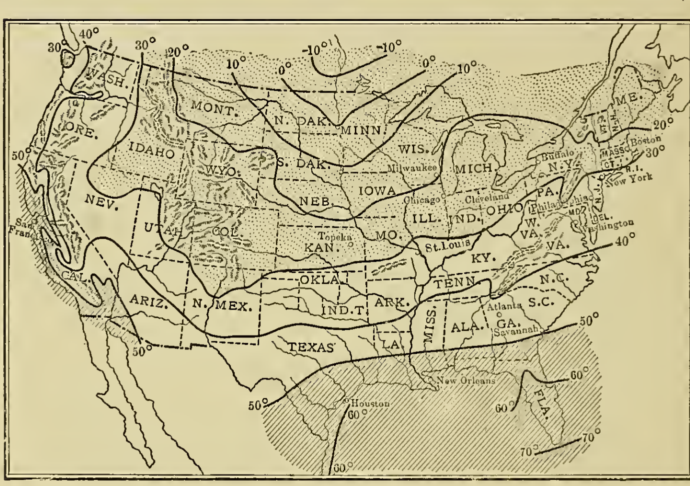


FIG. 63.

Isothermal chart of the United States for January. Why is it colder in the interior than on the east coast? Why so warm on the west coast? Can you notice any influence of mountains?

mate, even though in the torrid zone; and, for the same reason, plateaus may be colder than lowlands far north of them.

Besides that, land warms and cools much more rapidly than water (p. 39), so that land becomes hotter in summer and colder in winter than the ocean. Thus, in northern Minnesota, far from the coast, the average temperature in January is below zero, while in July it is about 65° (Figs. 63 and 64). In New York City, on the coast, the average in January is about 25°, and in July not quite 75°. On the west coast, in the state of Washington, where the winds are blowing from the ocean, the average temperature for January is 40° and for July 60°.

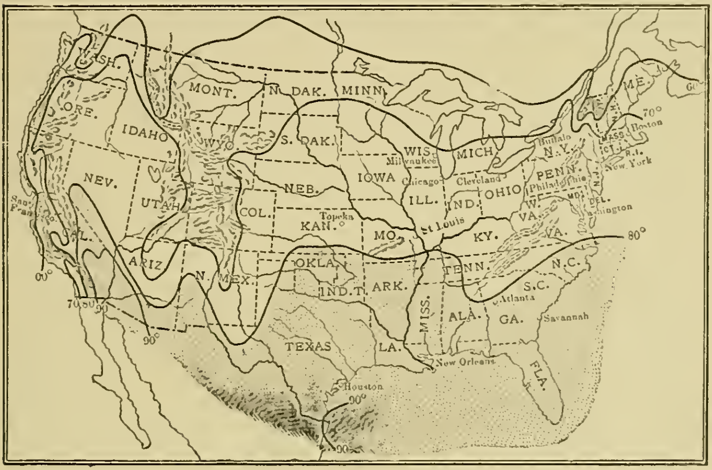


FIG. 64.

Isothermal chart of the United States for July. Notice the influence of the Rocky Mountains. Of the Appalachians. Why is it cooler on the west coast than on the east coast? What makes the isotherms bend northward in the Mississippi Valley?

At Key West, Florida, which is surrounded by water, the average temperature in January is about 70°, and in July about 85°. Where the temperature changes but little, the climate is said to be *equable*. Compare San Francisco and St. Louis in the two charts (Figs. 63 and 64).

The winds greatly influence the temperature. Where they blow from the ocean, they cause an equable climate, as in California, near San Francisco; but where they blow from the land, they are cool or cold in winter and warm in summer. This is true of the Eastern States, where most of the winds blow from the land, though some of the damp winds come from the ocean.

Another cause for different temperatures in places equally distant from the equator is found in the ocean currents. We have already seen that the Gulf Stream warms the air, while the cold Labrador current cools it, and that this air in movement forms warm and cold winds (p. 70).

If, therefore, we were to draw a line across the continent, connecting several points that have the same average temperature during any one month, or during the entire year, it would need to be a very crooked one, with some parts reaching much farther north than others. Such lines tell so much about temperature in so little space that it is the custom to make maps to show them, as in Figures 63 and 64. Since the lines connect the places having the same temperature, they are called *isothermal lines* or *isotherms*. (The first part of the word means *equal*, and the latter part *heat*.) A map or chart showing the isotherms is called an *isothermal chart* (Figs. 63 and 64). Trace several of the isotherms across the United States, and explain why they bend as they do.

Review Questions: *Waves and Tides.*—(1) Of what importance are the waves? (2) How often does the tide rise and fall? (3) What causes it? (4) What causes it to vary in height from place to place? (5) From time to time? (6) What important effects have tides?

Ocean Currents.—(7) Explain how winds help to produce ocean currents. (8) What is the cause of the cold water on the ocean bottom? (9) Describe the drift of tropical waters in the Atlantic.

(10) Trace the drift which passes outside of the West Indies to the European coast. (11) Describe the Gulf Stream. (12) Describe the Labrador current. (13) Trace the warm Japanese current. (14) What parts of the coast of North America are bathed by warm currents? By cold currents? (15) Tell about the discovery of the Gulf Stream by Franklin. (16) Of what importance is this current? (17) Tell about the ice which floats down with the Labrador current. (18) How does this current affect the climate of New England? (19) What influence has the Japanese current on the climate of western North America? (20) In what ways have the warm currents aided the building of many islands?

Distribution of Temperature. — (21) What about the change in temperature from equator to poles if the earth were a round ball of glass? (22) How is this change interfered with by elevation? (23) By distance from the ocean? (24) Give several examples. (25) What influence have the winds? (26) The ocean currents? (27) State several reasons why it is not always true that the farther north one goes, the colder it grows. (28) What is an isothermal line? (29) An isothermal chart?

Suggestions. — (1) If your home is upon the seacoast, find out about the high and low tides for several days in succession. (2) Notice the relation between the height and the time of high tide, on the one hand, and the changes in the moon, on the other. (3) From an almanac find out what the time and height of tide will be for some day in the following month. How do you think this prediction is possible? (4) Is the government obliged to spend money near your home to remove materials which the tidal currents have brought? (5) What course might a vessel take in order to be carried from Europe to America and back again by ocean currents? (6) What precautions do vessels take to avoid running into one another in dense fogs? (7) How do they try to avoid collisions with icebergs? (8) Learn more about Nansen's voyage. (9) Which of the isothermal lines on Figures 63 and 64 are nearest to your home? (10) Which isotherm on Figure 63 runs near New York and northern New Mexico? Near Savannah and San Francisco? Through southern Maine and southern Nebraska? (11) On Figure 64, which isotherm runs through northern Maine and San Francisco? (12) How about the distance of these points from the equator?

For References, see page 439.

V. CLIMATE, PLANTS, ANIMALS, AND PEOPLES

Fig. 65.

A map of North America, to show the four plant zones. Notice how irregular the boundaries are. Compare it with the isothermal chart, Figure 64, to see the cause. Also examine the relief map of North America, Figure 5.

Climate. — We have learned in the previous sections that several factors combine to determine the weather and climate of North America. The principal factors are (1) distance from the equator, (2) the changes of season, (3) elevation of the land, (4) distance from the ocean, (5) winds and storms, and (6) ocean currents. All these together determine the temperature and rainfall, which are the two most important elements of climate.

The climate of a region is one of the most important facts concerning it; for where temperature and rainfall are favorable, plants usually grow luxuriantly. And since plants furnish animals with food, where vegetation is luxuriant, animal life may be abundant.

Since North America extends far north and south, and possesses lofty mountain ranges and enclosed plateaus, it has a great variety of climates, and, therefore, a great variety of plant and animal life (Fig. 65).

Plants of the North. — The northern part of the continent is bitterly cold. In that region there is a vast area where the soil is always frozen, excepting at the very surface, which thaws out for a few weeks in summer. On account of the frost, trees such as we are familiar with cannot grow. Their roots are unable to penetrate the frozen subsoil and to find the necessary plant food. There are some willows, birches, and a few other plants with woody tissue, bark, leaves, and fruit; but instead of towering scores of feet into the air, they creep along the surface like vines, and rise but an inch or two above ground. Only by thus hugging the earth can they escape the fierce blasts of winter and find protection beneath the snow.

FIG. 66.
Arctic poppies growing on the edge of a snow-bank.

A few grasses and small flowering plants grow rapidly, produce flowers, even close by the edge of snowbanks (Fig. 66), and then pass away, all within the few short weeks of summer. Some of these plants produce berries, which after ripening are preserved by the snows; thus, when the birds arrive in the spring, they find food ready for them.

Animals of the North. — The summer development of insects is rapid, like the growth of plants. As the snow melts and the surface thaws, the ground becomes wet and swampy, and countless millions of insects appear. Among them the most common is, apparently, the mosquito. There are few parts of the world where this creature is a worse pest than on the *barrens* of North America and the *tundras* of Europe and Asia, as these treeless, frozen lands are called.

Few large land animals are able to thrive in so cold a climate and where there is such an absence of plant food. The reindeer, or caribou, the musk-ox, polar bear, white fox, and Arctic hare are the largest four-footed land animals (Fig. 67); and the crow, sparrow, and ptarmigan are the most common land birds.

The ptarmigan changes its plumage to white in winter, and other animals of the Arctic, such as the fox, polar bear, baby seal, and hare, are also white. This serves to conceal them, in that land of snow and ice, so that they may hide from their enemies, or steal upon their prey unawares.

The tiny white fox feeds upon birds and other animal food; but the other land animals, except the polar bear, live upon plants, such as berries, grass, and moss. The caribou finds a kind of plant, called "reindeer moss," which grows upon rocks that rise above the deep winter snows. If it were not for this, the reindeer would not be able to live through the long winter.

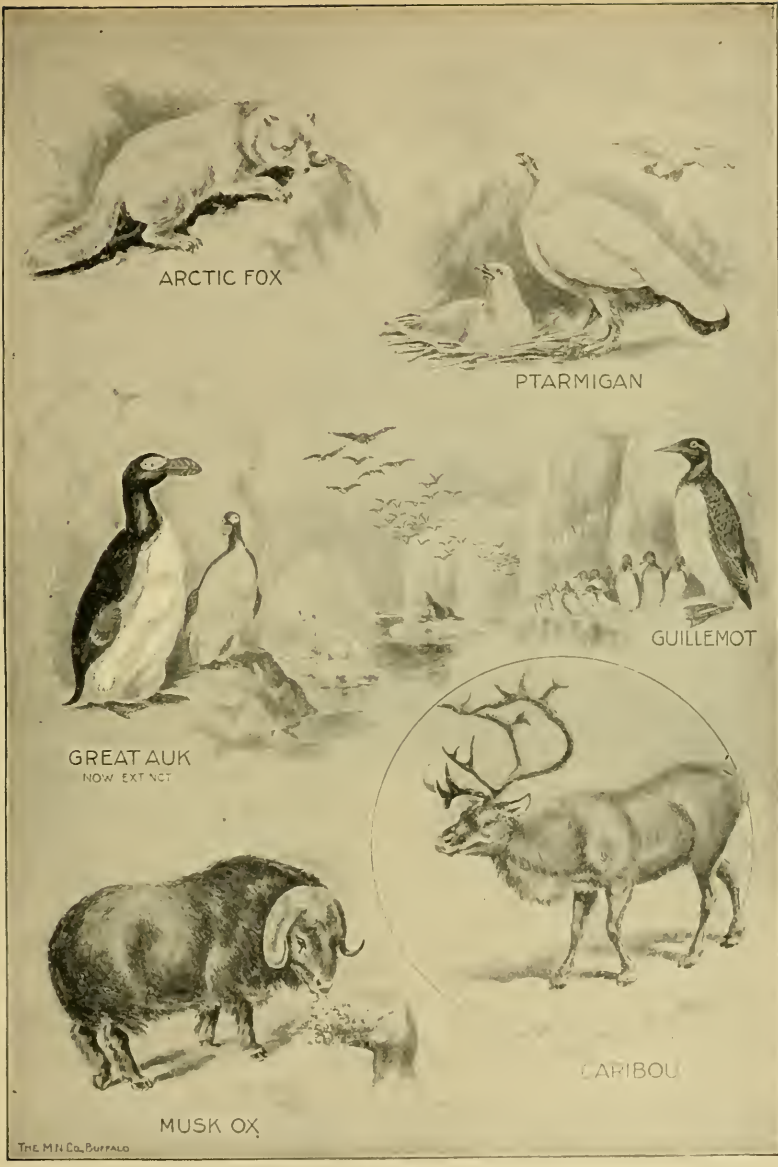


FIG. 67.

Some of the animals of the North. The great auk had such small wings that it could not fly. It was killed in great numbers by sailors, and has been completely exterminated.

While some animals live upon the land in the Arctic regions, many more have their homes in the sea, because there, excepting at the very surface, the temperature never descends below the freezing point. Therefore, there is plenty of animal life of all sizes, from the very tiniest forms to the whale, the largest animal in the world (Fig. 254, p. 326). During the winter the surface of the sea freezes over; and then many of the sea animals migrate southward. Even the huge walrus (Fig. 68) moves clumsily toward a more favorable climate. The birds go farthest, especially the geese, ducks, and gulls, which fly to Labrador, New England, North Carolina, and even farther south, to spend the winter where their food is not covered by ice.

Fig. 68.
Walrus on the Arctic floe ice.

Sea birds exist by hundreds of thousands (Fig. 67), building their nests upon rocky cliffs in immense numbers. Indeed, they are so numerous that, when suddenly frightened, as by the firing of a gun, they rise in a dense cloud that obscures the sun. Then, by their cries they produce a din that is almost deafening. In the water live seals (Figs. 62 and 286) and walruses, the former being so valuable for their oil and skins that men go on long voyages to obtain them. The oil comes from a layer of fat, or "blubber," just beneath the skin, that serves to keep out the cold.

The seal is the most common of the Arctic sea animals, and is the principal food of the Eskimo and the polar bear (Fig. 62). The bear, protected from observation by his white color, stealthily creeps upon his prey, asleep upon the ice; or, he patiently watches until his victim swims within reach, and then seizes him in his powerful claws.

Life on Mountain Tops. — In many respects the life on mountain tops resembles that of the Arctic regions. On the crests of lofty mountains it is cold, and large animals are rare, while the plants resemble those of the cold North (Fig. 74). There are no trees, though creeping willows and birches abound. Indeed, some of the plants are actually the same as those of the North. For instance, on the top of Mt. Katahdin, Maine, some of the plants are of the same species as those thriving in Labrador, Baffin Land, and Greenland. Arctic plants also occur on the mountain tops in North Carolina.

Plants and Animals in Western North America. — A large area in western United States and Mexico has a very slight rainfall, although its temperature is agreeable. This arid area includes most of the territory having less than twenty inches of rain (Fig. 46, p. 50). In some places, as near the Pacific coast and upon the mountain tops and high plateaus, there is rain enough for forests to thrive; but in most parts of the Far West the climate is so dry that there are no trees whatsoever. Indeed, some portions of the West are desolate in the extreme and almost devoid of life, both plant and animal; in other words, they are true deserts.

One common plant is the bunch grass, so called because it grows in little tufts or bunches. The sage bush, a plant with a pale green leaf, named because of its sagelike odor, is found throughout most of this arid region. Other common plants are the mesquite, the century plant with its sharp-pointed leaves (Fig. 304, p. 383), and the cactus with its numerous thorns. In favorable spots, especially in the warm southwest, the mesquite grows to large size; and the cactus, which in the north is always low and represented by only a few kinds, in the southwest, as in Arizona, grows in great variety and, in some cases, even to the height of trees (Figs. 69 and 45, p. 49).

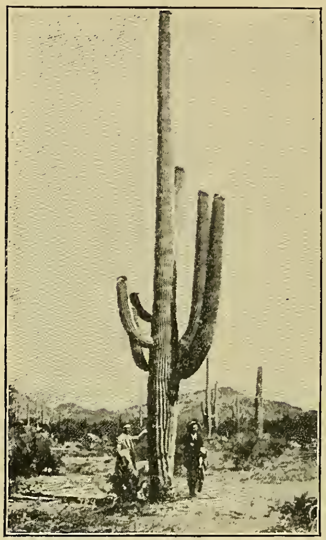


Fig. 69.

Giant cactus in the desert of southwestern Arizona.

Fig. 70.

One of the peculiar plants of the arid lands, growing to the size of a tree in the warm, dry climate of southern Arizona.

On account of the extreme dryness of the climate, these plants have a severe struggle for existence, and adopt peculiar means for protecting themselves. For example, the cactus, unlike other plants, has no leaves. It thus exposes little surface to the air for evaporation. In its great, fleshy stem it stores water to use through the long, dry seasons, while spines protect it from animals in search of food. The mesquite also protects itself by spines, and in addition has such large roots that the part of the plant under ground is greater than that above. Many of these plants, as the mesquite, are so bitter that they are not eaten by animals.

Animals eat few of the arid land plants except the grasses, which were once the food of the buffalo or bison (Figs. 71 and 76), and are now the support of cattle and sheep (Figs. 77 and 288, p. 362). The bison, whose home

FIG. 71.
Photograph of a young bison.

was on the prairies and the arid plains east of the Rocky Mountains, is now gone; and few large animals are left in its place. The cowardly prairie wolf, or *coyote*, and the graceful antelope and the rabbits upon which it feeds, are the most abundant (Fig. 72). Among the rabbits is the long-legged jack rabbit, which leaps across the plains with astonishing speed, with its huge ears thrown back so far that they do not retard its progress.

The traveller through the arid lands meets with few more interesting creatures than the prairie dogs which live in small communities, called prairie-dog towns (Fig. 72). Their homes

Fig. 72.

Some of the animals of the plateaus and mountains of the Far West.

are in the ground and their food consists of grass. They do not venture far from their burrows for fear of the coyotes which may be lurking near; and upon the least alarm they utter a shrill note and tumble headlong into their burrows.

There are birds and some lower animals, as the poisonous tarantula, centipede and scorpion, besides snakes, especially the poisonous rattlesnake (Fig. 72).

The fierce puma or mountain lion still lives among the mountains, and also the ugly cinnamon and grizzly bears (Fig. 72), though the latter are now rare and difficult to find. Deer and elk inhabit the forest-covered mountains of southern Canada and northwestern United States; and among the higher peaks a few mountain goats and sheep still live on the more inaccessible rocky crags (Fig. 72). The sheep have huge horns much prized by hunters.

Plants and Animals of the Tropical Zone. — Contrast the life in the frozen North and the arid West with that in Central America and southern Mexico. In these regions, which are situated in the torrid zone, the temperature is always warm; and the rainfall, especially on the eastern coast, is so heavy that all the conditions are favorable for dense vegetation.

Indeed, the tangle of growth in the forests is so great that it is practically impossible to pass through it without hewing one's way. Besides trees and underbrush, there are quantities of ferns, vines, and flowers, many of which hang from the trees with their roots in the air instead of in the ground (Fig. 41, p. 46). They are able to live this way on account of the damp air. Among the trees are the valuable rosewood, mahogany, ebony, and rubber tree; and among the flowers are the beautiful orchids. On account of the continual warmth and moisture, many plants, like the banana for instance, bear fruit throughout the year.

In the midst of such luxuriant vegetation, animal life is wonderfully varied and abundant. There are the tapir, monkey, and jaguar (Fig. 73); brilliantly colored birds, such as parrots, paroquets, and humming birds; and millions of insects. Scorpions and centipedes abound, and ants exist in countless numbers, some in the ground, others in decayed vegetation. Serpents, some of them poisonous, are common in the forests; and in the rivers are fish and alligators, the latter being found as far north as Florida and Louisiana.

The plants and animals of the torrid zone are well adapted to their surroundings, like those of the Arctic and the desert. The jaguar and ocelot are speckled, or spotted, like a surface upon which the sunlight plays when it has struck through deep shade; the brown alligator is in color much like the mud banks on which he lies; and all the brilliantly colored animals are in harmony with the intense lights and the bright hues of tropical plants. This resemblance to their surroundings aids them in hiding, whether from their own enemies, or from the creatures which they are seeking for food.

Plants and Animals in the Temperate Part of North America. — Between the frigid and torrid zones, and both east and west of the arid region, is an area of *moderate* rainfall and temperature where the vegetation and animals differ from those of the other sections. Beginning in the warm South and passing northward, we find that both animals and plants grow less numerous and less varied until, near the Arctic zone, they become scarce and few in kind. The pines and oaks of the United States give place to the spruce, balsam fir, and maple in Canada; then these gradually become stunted and disappear (Fig. 74), and beyond this the barrens are reached (p. 78).

Fig. 73.

A few of the animals of the tropical forests.

The animals that once inhabited the broad temperate zone have been mostly destroyed, although some still live in the forest and mountain region. They are carefully protected by state laws, which prohibit shooting except at certain seasons, and then only in small numbers. When America was first visited by Europeans, these woods abounded in deer, moose, caribou, wolves, and foxes (Fig. 75). Beavers built dams across the streams, the mink and otter fished in the waters, and bears roamed at will.

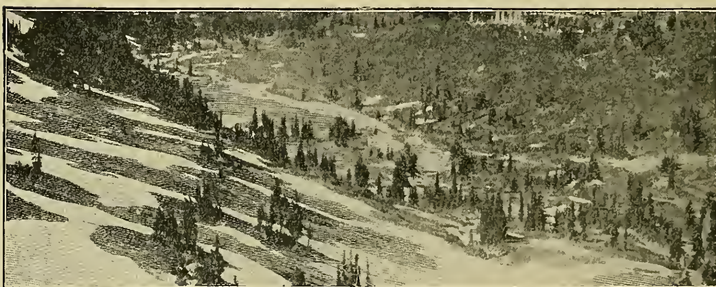


FIG. 74.

Appearance of the trees at the tree line, both on the slopes of mountains and near the Arctic zone.

Among the birds, the eagle was common (Fig. 75), and wild pigeons and turkeys were so abundant that they were one of the principal foods of the early settlers.

Some believe that at one time most of eastern United States was wooded, including the fertile prairies of the Mississippi Valley, from which the trees were burned by fires set by the Indians. Grass then sprang up in place of the trees, and the prairies became the grazing place for immense herds of bison (Figs. 71 and 76). The bison, however, like the other animals mentioned, have been mostly destroyed; thousands upon thousands were slaughtered for their hides and tongues alone, and

Fig. 75.

Some of the animals of northeastern United States and southeastern Canada.

their bones left to whiten upon the plains. There are now no wild bison in the United States, except a few which are protected by the government in the Yellowstone National Park. In this Park, where hunting is prohibited, are numbers of deer

Fig. 76.

One of the immense herds of bison that formerly roamed over the treeless plains.

and elk (Fig. 72). There are also black, cinnamon, and grizzly bears, which are so tame that they come down to the hotels at night to feed upon the garbage.

Cultivated Crops and Domesticated Animals. — A slow change has been in progress in this temperate section, which, when first discovered, was clothed in forests and luxuriant prairie grass, and inhabited by Indians and wild beasts. The white man has come into possession of the land and has cleared the forests and ploughed the prairies, so that, where trees stood and Indians hunted game, there are now fertile farms and thriving cities.

The laws of climate that determine what kinds of plants and animals shall live in the different sections, are also governing man himself to a certain extent. He is able to raise sugar and cotton in the South; but north of this there soon comes a belt where these crops cannot be raised, though corn may be produced. Still farther north, even corn cannot be grown, but oats, barley, and other hardy crops. Farther north still, man has been obliged to leave nature much as it always has been. In the arid lands, however, he has been able to raise products, even in the desert, wherever water can be led to the thirsty soil.

His domesticated animals have also been influenced somewhat by surroundings. In the arid portions of the

Fig. 77.

Cattle feeding on the Great Plains, where the herds of bison formerly roamed.

Far West, cattle have been allowed to roam in a semi-wild state where the bison formerly lived. But in the more humid central, eastern, and southern sections, where the land is better suited to agriculture, cattle are more carefully reared. Those in the West are raised principally for their meat and hides; but those in the East furnish, in addition, milk for butter and cheese.

Crops and domesticated animals well illustrate how man has learned to make use of nature for his needs. Every one of our cultivated plants was once a wild plant; and each of our domesticated animals has been tamed from the wild state. Most of these have come from Europe and Asia; but America has added some to the list. Among plants in common use, the Indian corn or maize, the tobacco, tomato, pumpkin, and potato were unknown to the Old World until America was discovered. The same is true of the turkey; and perhaps, in a hundred years or so, the bison may be included among the domesticated animals, for on the cattle ranches of the West a few small herds are being carefully reared.

Peoples

Eskimos. — America was inhabited for thousands of years before it was discovered by white men. To the natives in the southern part Columbus gave the name *Indians*, supposing he had reached India. Those in the Far North, who subsist on meat, are called Eskimos, a word meaning flesh-eaters.

Fig. 78.

An Eskimo woman carrying her baby in the sealskin hood on her back.

To-day, in some places, the Eskimos live in very nearly the same condition as formerly, their climate being so severe that white men have not settled among them nor interfered with their customs. They still roam about in summer, living in skin tents, or *tupics*, and in winter erecting snow and ice huts, or *igloos* (Fig. 79). Their struggle is a hard one, for they not only have to battle against cold, but also to obtain their food amid great difficulties. In this they are aided by their dogs, which are doubtless domesticated wolves, and which, like their masters, are able to subsist upon a meat diet and with-

Fig. 79.
Eskimo igloos in Baffin Land.

stand the severe Arctic cold. Every Eskimo man has his team of dogs to draw his sledge over the frozen sea.

Indians. — Indians were originally scattered over most of the country south of the Arctic Circle. This is indicated by the places that bear Indian names, as Narragansett, Erie, Niagara, Huron, Ottawa, Illinois, Dakota, Pueblo, and Sioux City. Some of the tribes were true *savages;* others, not so savage, may be classed as *barbarians.* They raised "Indian corn" and tobacco, baked pottery, used tools and weapons made of stone, and lived in villages.

These two classes of Indians had no settled homes, but roamed about. They generally followed regular paths, however, moving from place to place with the season. Their homes were skin tents commonly pitched in a group and forming a village. The women and children spent most of their time in the villages, near which were fields of Indian corn cultivated by the women. The men fished along the seashore, on the lakes, or on the rivers, and hunted in the forests or on the prairies. They travelled about through the woods, sometimes along the rivers in their birch-bark canoes, sometimes on foot along narrow paths, or *trails.*

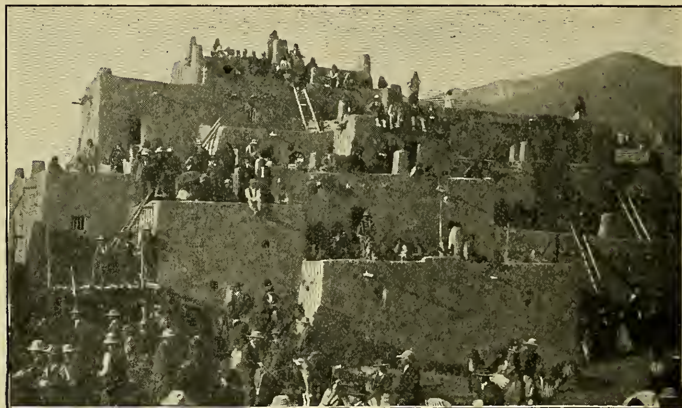


Fig. 80.

The pueblo of Taos in New Mexico. Notice the ladders leading to the roofs upon which are the house entrances.

In southwestern United States, Mexico, and Central America the aborigines were more civilized. Much of that region is arid; but the Indians raised crops by irrigation, and built fortresses of stone and sun-dried brick (Fig. 80). These were erected partly as homes for protection from surrounding savages, and partly as storehouses for grain.

The most noted among these Indians were the *Aztecs*, who occupied the city of Mexico and some of the neigh-

FIG. 81.
Indian blankets, woven by one of the tribes near the boundary line between New Mexico and Arizona.

boring country. They had government and religion much better developed than the barbarous and savage tribes. They mined gold and silver and manufactured the metals into various articles; they wove blankets, and ornamented their pottery and their buildings in an artistic manner. Living the quiet life of the farmer, the Aztecs preferred peace to war, and a settled home to the nomadic life of the hunter. But even these Indians were not truly civilized; they lacked many of the arts of civilization, as for instance, that of writing, though they, together with other Indians, were able to convey their ideas by drawing pictures.

FIG. 82.
Indian carrying a decorated pottery jar.

While some tribes thus approached a state of civilization, the Indians, as a race, never became a powerful people. For this there are several reasons. Instead of forming one great confederacy and living at peace with one another, they were divided into many tribes.

Each tribe had a certain area over which it could roam and hunt; but if it encroached upon its neighbors, war followed. Under these circumstances it was difficult for one tribe to advance to a much higher state of civilization than the others.

The level nature of the country rendered this difficulty all the greater. Had the surface of North America been very mountainous, some tribes might have been so protected by surrounding mountain walls as to dare to devote themselves to other work than war. Then they might gradually have collected wealth and developed important industries; but the vast plains of the Mississippi Valley, which make up so much of the continent, and the extensive plains and low mountains of the East, allowed little protection. If any one tribe had built good homes on these plains, and collected treasures within them, the neighboring Indians would have felt that a special invitation had been extended to attack them. The Aztecs were continually in danger from this cause. However, the fact that they were *partly* protected by mountains and deserts, especially in southern Mexico, was one of the reasons why they were more civilized than the Indians of the northeast.

FIG. 83.
Indian woman carrying her baby, or *pappoose*.

Another serious obstacle to the advancement of the Indians was the fact that they possessed no domestic animals for use in agriculture. The horse, cow, ass, sheep, goat, and hog were unknown to them; and, without these, farm work becomes the worst drudgery, because every product must be raised by hand. It is not surprising, then, that the men left the farming to the squaws, while they spent their time in war and in hunting.

Again, although there was much game, the supply was never sufficient to support a dense population for a long period. Even the scattered Indian population was obliged to wander about in search of it. This prevented them from living quietly and finding time for improvement. All these facts worked against the advancement of the Indians; but they proved of great advantage to the whites, making it far easier than it would otherwise have been for them to obtain possession of America.

The Spaniards. — The astonishment of Europe was great when it was proved that there were vast territories on this side of the Atlantic. America was pictured as containing all sorts of treasures, and European nations vied with one another in fitting out expeditions to take possession of them.

The Spaniards naturally led, for they were then one of the most powerful nations of Europe and had sent out Columbus as their representative. Leaving Palos in Spain on his first voyage, he came within reach of the trade winds, which carried him southwestward to one of the West Indies, a point much farther south than Spain itself. Find on a globe the point on our coast that is about as far north as Madrid. Had Columbus started from England, he would have sailed into the prevailing westerlies, instead of the trade winds; and, although the distance is shorter, the voyage would have required a much longer time. Why?

The section reached by the Spaniards had a climate similar to that of their own country, and they easily made themselves at home there and soon came into possession of most of South America, Central America, Mexico, and southwestern United States. They had one advantage over the English and French who settled farther north: the portion of the continent that they discovered is so narrow that they easily crossed it, and thus enjoyed the privilege of exploring the Pacific coast also. It was because of this fact that the Spanish race settled the western coast as far north as San Francisco.

After robbing the Aztecs of immense quantities of gold and silver, the Spanish converted the natives to Christianity, and introduced many Spanish laws and customs. They cruelly mistreated the natives, killing many and enslaving others, and forcing them to work in the mines and fields. They almost completely exterminated the Indians who lived in the West Indies. While the invaders were able to conquer the semicivilized Aztecs and the barbarians of the islands, they made very little progress in subduing the more savage tribes. To this day, in fact, there are tribes of Indians in Mexico and Central America that have never been conquered, and that frequently cause trouble.

The French. — The French began their settlements in a very different quarter, being first attracted to our coast by the excellent fishing on the Newfoundland banks. Soon the fur trade with the Indians proved profitable, and the French took possession of Nova Scotia and the region along the St. Lawrence River and the Great Lakes.

The value of the fur trade, and a desire to convert the Indians to Christianity, led the French far into Wisconsin and to the head waters of the Mississippi River. Making their way southward to the mouth of that river, they took possession of the whole Mississippi Valley (Fig. 84), and called it Louisiana in honor of their great king, Louis XIV. In order to hold this vast territory, they established a chain of trading posts and forts from the Gulf of Mexico to the Gulf of St. Lawrence. One of the most important of these forts stood where Pittsburg now stands.

What special advantage had the French for reaching so much of the interior of the continent? Why should they not have proceeded westward to the Pacific? Many places in the St. Lawrence and Mississippi valleys still preserve French names, as Lake Champlain, Marquette in Michigan, La Salle in Illinois, St. Louis, and New Orleans.

The English. — The Spanish and French left only a narrow strip along the Atlantic coast for other nations. Among those who attempted settlements were the Dutch in New York and the Swedes in Delaware. But the English, settling at various points along the coast, soon obtained the lead. They captured New York City (then called New Amsterdam) from the Dutch, and extended their settlements along most of the coast from Florida to Nova Scotia.

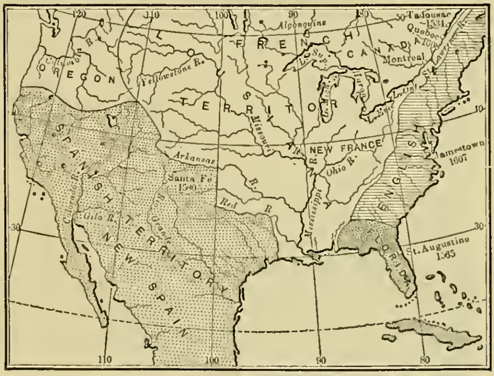


FIG. 84.

Map showing the claims of France, England, and Spain upon the territory of Central North America in 1760.

In several respects the portion that fell to the English seemed much less desirable than that held by the Spanish and French; yet the English speaking race has managed, not only to retain this, but to add to it most of the possessions of the other two. At the present time, the control of the entire continent, with the exception of Mexico, Central America, and a few small islands, is in the hands of either the United States or Great Britain.

There are, of course, good reasons for this strange result. No doubt original differences between these three races is one cause; but there are others also. In the case of the Spanish, the climate has been one factor; for in a large part of their territory the weather is too warm to produce energetic people. In very cold countries, as in the land of the Eskimos, so much labor is required in merely obtaining food and shelter, that little time and strength are left for general improvement. The struggle is too severe to allow progress.

In warm countries, on the other hand, the same effect is produced, but in the opposite way. So *little* energy is required to find sufficient food that the people do not *need* to exert themselves, and hence do not. By taking a few steps, the Central American can find bananas and other nourishing food at almost any season of the year; why then should he work? The people, therefore, lose the inclination to bestir themselves, or, in other words, become too lazy to improve their condition.

Fig. 85.

A primitive Mexican cart with wooden wheels, such as can still be seen in that country.

Another reason why the Spaniards have not developed is found in their relation to the Indians. Although robbing and enslaving them, they at the same time married them freely, so that, in time, half-breeds have come to make up more than half the population. These half-breeds are an ignorant class, far inferior to the Spaniards themselves, and so backward (Fig. 85) that they still follow many of the customs of the Aztecs.

The French likewise intermarried with the Indians and adopted some of their customs, although not to so great an extent as the Spaniards. Their climate was, on the whole, more favorable than that of the Spanish; for, though cold in the St. Lawrence Valley, the temperature was conducive to effort. But one of their greatest difficulties arose from the fact that the few scattered settlers were unable to protect all of the vast territory to which they laid claim.

As for the English, the temperate climate of their section is the best in the world for the development of energy. The warm summers allowed abundant harvests; but the long, cold winters forced the settlers to exert themselves to store supplies for the cold season. Since it required only a reasonable amount of labor to obtain the necessities of life, time and energy were still left for improvement.

In their treatment of the Indians, the English and French were less cruel than the Spaniards; but, unlike both French and Spanish, the English would not intermarry with savages. Consequently, in the wars with the French, the English were not hampered by great numbers of half-civilized persons, and could act with more intelligence, speed, and force. Their relation to the Indians, however, placed them at a disadvantage in one respect; for, during the fights with the French, a majority of the Indians were allies to those with whom they had intermarried, and, hence, were friends to the enemies of the English.

The fact that the English were hemmed in by forest-covered mountains on the west, and by the French and Spanish on the north and south, also proved an advantage; for on that account they were kept close together, and were easily able to combine their forces when wars arose.

These are some of the reasons why the English-speaking race has won its way on the continent against both Spanish and French. Spain has steadily lost ground, having recently given up Cuba and Porto Rico to the United States; and France has had no claim upon the continent since 1803. The Spanish race still occupies Mexico and Central America, while French is even now spoken by many people in New Orleans, Quebec, and Montreal.

Westward Migration. — After the Revolutionary War, by which the Thirteen Colonies gained their independence from Great Britain, an active westward movement began. For a long time the Appalachian Mountains had stemmed the tide of migration (Fig. 86). But at last numbers of pioneers found their way, along the river valleys, to the other side of these mountains. There they discovered fertile plains, free from rocks and woods, and ready for the plough; and their enthusiastic reports quickly drew hundreds of thousands after them.

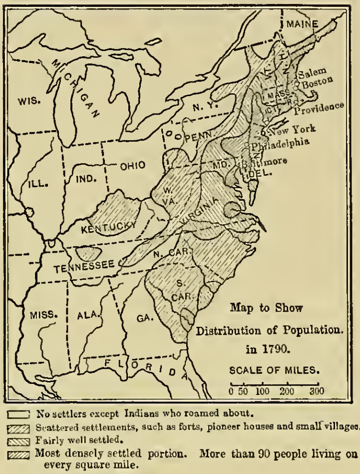


Fig. 86.

Map to show the settled part of the United States in 1790. Notice the cities named; each of these had over 5000 inhabitants. Which are now among the great cities of the country? What about Chicago?

The westward advance pushed the frontier line on and on until the semi-arid plains of the West were reached. Then, in 1848, the discovery of gold in California produced a wave of excitement that carried hosts of adven-

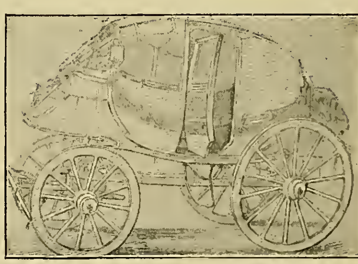


Fig. 87.

A stage coach used three-quarters of a century ago to travel through the wilderness of western New York.

turers across the Rockies to the Pacific coast. After this the western part of the United States was rapidly explored and settled.

Indian Reservations. — Through this movement the Indians found themselves driven from their hunting grounds, and their resentment toward the whites led to many a massacre. However, they were outnumbered by civilized people, and, in spite of their stealth, courage, and endurance, were soon a conquered race.

It has been necessary to confine the Indians to certain regions, called *Indian reservations*, in various parts of the East and West. There are small ones in Maine, New York, and Florida, and larger ones in the West; but the largest is Indian Territory, just north of Texas.

In collecting the Indians upon reservations it was intended to encourage them to adopt civilized customs, to build homes, and to cultivate the soil. For that purpose the government has placed *Indian agents* upon the reservations to supply the Indians with necessary articles, such as farming tools, seed, clothes, and, in time of need, food also. Often each Indian is assigned a small farm to cultivate as he chooses, and his children are sometimes forced to attend a school.

While the plan has worked well in some cases, for the most part it has proved a dismal failure. The Indians have been roaming about for too many generations for all of them to be ready to settle down peaceably and toil at farming. Many of them are too lazy for this kind of work; and, even after taking the trouble to prepare the ground and sow the seed, they sometimes abandon their crops in order to hunt and fish.

The government system of supplying them with necessaries encourages them in their shiftlessness, for they know that when winter comes they will not be allowed to starve. Other reasons for the failure are, unfortunately, dishonesty of the Indian agents in some cases, and also the failure of the government to carry out its agreement with the Indians. In other cases, the allotment of poor land to the Indians has caused trouble. We owe it to the red men to see that they are offered every chance to rise to civilization, and the reservation system has not led to that result.

There are, of course, numerous exceptions, for many tribes and individuals have greatly profited from government aid. Some have shown themselves capable of a high degree of civilization, as is proved by the students in the Indian schools at Hampton, Virginia, and Carlisle, Pennsylvania. A better system of treatment for the Indians is now being tried; that is, to do away with reservations, to supply each Indian with a farm, and to force him to depend upon himself.

Slavery. — While the Indians of the East were being killed in war and driven westward, negroes were being brought from Africa. There are now fully eight million blacks in the United States, which is nearly one-ninth of our entire population, and thirty times the number of Indians.

Slavery was first introduced into America by the Spaniards, who made slaves of the Indians, and afterward imported negroes from Africa. The first negro slaves in the British colonies were brought to Virginia in 1619, but their number increased very slowly until the close of that century. The demand for cheap labor was partly supplied by criminals sent over from England, and by other immigrants who gave their services for a few years in payment for their passage across the sea. Many of these were men and women of good character, who became respectable citizens. Many others, however, were outcasts from society.

As the settlement of Virginia increased, and slave labor was substituted for that of the "poor whites," the latter, often the descendants of the bond-servant of early days, sought refuge on the southern and western frontier. Some of the descendants of these people have become most respectable citizens, others form the so-called "white trash," which are found scattered through the Southern States. Among their descendants, too, are some of the people who dwell among the mountains, living to this day the life of the backwoodsman, and now and then engaging in illegally distilling whiskey from corn raised in small patches on the mountain slopes.

Negro slaves were brought to all the colonies, but they soon proved a much more profitable investment in the South than in the North. In New England the farms were small, the products were numerous and their cultivation required considerable skill. Moreover, the climate was severe for natives of tropical Africa. On the other hand, the Southern climate was well suited to them; and the simple routine work upon the great tobacco, cotton, sugar, and rice plantations was such as they could easily perform. Accordingly, the number of slaves increased in the South, while slavery gradually disappeared from the North.

Fig. 88.
A negro group in the South.

When steam began to turn the factory wheels of England, the demand for cotton from America greatly increased; and the invention of the cotton gin, in 1793, made its production far more profitable than before. On that account the slave-trade grew into an enormous industry, and slavery became apparently a necessary institution in the Southern States. Men, women, and children were bought by slave-traders, — often Northerners or foreigners, — and sold to the plantation owners.

Since slavery was abolished by the Civil War, the number of negroes has increased in the South, although many have migrated to the North and West. In most cases the slaves were well treated by their owners, but they were of course very ignorant, and the close of the war found the great majority of them totally unfitted for the duties of citizenship. It has been one of the great problems to determine what shall be done to educate and improve the condition of the negro. Many people in both North and South are deeply interested in it, though it is a matter in which the South has the more vital interest, since there are so many negroes in the Southern States, where they are depended upon to perform most of the labor. It is believed that the problem of improving the condition of the negroes is being solved by such schools as that at Hampton, Virginia, and Booker Washington's Tuskegee Institute in Alabama.

Immigrants to America. — Europe and Asia, as well as Africa, have poured forth a stream of immigrants into this country. Our increase in population, from a little over three millions at the close of the Revolutionary War to over seventy-six millions at present, has been possible only as a result of this steady stream from abroad. Nearly every foreign nation is represented, and upon the streets of our larger cities may be heard the languages of most of the civilized peoples of the globe.

The greater part of our immigrants has come from northern Europe, especially from the British Isles, Germany, and the Scandinavian peninsula (see table, p. 454);

and great numbers of them have settled in the cities. More recently a flood of immigration from southern Europe has brought us less educated and less desirable people. At one time many Chinese threatened to come, and laws preventing their coming had to be passed. We have laws, also, excluding paupers, criminals, and laborers who are brought here by contract. To others the country is free, though many believe that very ignorant persons should be prevented from immigrating here.

It has been our mission to welcome these strangers, and, in spite of their varying ideas, customs, and languages, to teach them the principles of a republican form of government, to educate them, and, welding them into an harmonious body, to make them good citizens and true Americans. It is not strange if some mistakes have been made in the process. It is a task that no other nation has ever performed on so grand a scale. Nevertheless, the fact that so few of the many foreigners who settle among us desire to return to their native lands is proof that they have not been disappointed in their expectations; and it suggests reason for a well-founded pride in the government of the United States, and a hope for its future.

Review Questions. — (1) What factors determine climate? (2) Of what importance is climate? (3) Why are there no large trees in the cold North? (4) Describe the vegetation there. (5) What animals live on the land there? (6) Tell what you can about each. (7) Why are there more animals in the sea? (8) What kinds live there? (9) How does the life of mountain tops resemble that of the frigid zones? (10) How do arid land plants protect themselves? (11) Tell what you can about the animals living in the arid lands. (12) Why should there be more life in the tropical zone? (13) Name some of the plants living there. (14) Name some of the animals. (15) How do they protect themselves? (16) What can you say of the plants of the moist temperate zone? (17) Of the animals? (18) Of the bison? (19) How does climate influence the cultivated crops? (20) The domesticated animals? (21) What cultivated plants and domesticated animals has North America supplied? (22) Describe the difficulties that the Eskimos encounter. (23) Give some examples of Indian names. (24) Describe the life of the savage and barbarous Indians. (25) Of the semi-civilized Aztecs. (26) What causes prevented the Indians from becoming more civilized? (27) Give a reason why the Aztecs were able to advance. (28) What winds aided Columbus to discover southern countries? (29) What advantage did their location in southern North America give the Spaniards? (30) How did the Spaniards treat the Indians? (31) What attracted the French to America? Where did they settle? (32) What other nations settled in the East? (33) What has been the fate of the Spaniards and French in America? (34) Why have the English-speaking people come into possession of the greater part of the continent? (35) What interfered with the westward migration of the English? (36) How was this migration finally brought about? (37) What effort has been made to care for the Indians? Why has it failed? (38) Tell about the beginnings of slavery in America. (39) Why was it more successful in the South than in the North? (40) What is the condition of the negroes now? (41) Where do our immigrants come from? (42) What is our mission toward them?

Suggestions. — (1) Examine some century and cactus plants. (2) Find some furniture made of mahogany or other tropical wood. (3) Visit a greenhouse to see orchids. (4) Collect pictures of native plants and animals of North America. (5) Collect samples of different American woods. (6) What does the eagle signify as our national emblem? On what coins is it found? (7) What have you read about the bison? About Indians? Write a story about each. (8) Explain more fully why domestic animals are necessary to civilized life. (9) Write a story about slavery times. (10) Do you know any of the negro melodies that were sung on the plantations?

For References, see page 439.

VI. LATITUDE, LONGITUDE, AND STANDARD TIME

Latitude and Longitude

Need of a Means for Locating Places. — You have doubtless noticed that it has frequently been necessary to refer to lines upon the earth, such as the Tropic of Cancer, the Equator, the Arctic Circle, etc., in order to locate certain places and the boundaries of the zones. But these lines are far apart, and there are many places between them to which reference must often be made. For instance, suppose we wished to state on what part of the earth London is situated; how could it be done? Of course, by taking a long time, it would be possible to describe just where this city is; but cannot some more convenient way be devised?

The difficulty is much the same as that which arises in a large city. There are thousands of houses in the city, as there are thousands of towns and cities in the world. No one person knows who lives in most of them, and if a stranger were looking for a friend, he might have much trouble in finding him.

The Streets of a City. — In this case the problem may be solved in a simple manner. A street running east and west may be selected to divide the city into two parts (Fig. 89). Any place north of this street is spoken of as being on the north side, and south of it as being on the south side. The streets to the north and south are numbered from this, as North 1st, North 2d, North 3d ; and South 1st, South 2d, South 3d, and so on. Then if a man says that he lives on North 4th Street, one knows immediately that he lives on the north side, and that his house is on the 4th street from this central one.

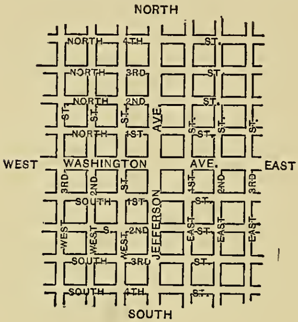


Fig. 89.

Map of a part of a city, to illustrate the need of naming streets.

But a city also extends a long distance east and west, and we need to know on what part of 4th street this house is to be found. To answer that question, another street running north and south, and crossing the east and west ones, may be selected to divide the city into east and west parts. The streets on the two sides are numbered from this one, as East 1st, East 2d, West 1st, West 2d, etc. (Fig. 89).

Then if a man lives on the corner of North 4th and East 3d streets, one knows not only that his home is *north* of a certain line, but *east* of another line. If the blocks, or the space between any two streets, are always the same, it will also be easy to tell the distance from each of the central streets to the house.

This plan is not necessary in small towns and villages, because the people there know one another, and are able to direct strangers easily. Few, if any, cities follow *exactly* the scheme here given; but many have a system of naming or numbering streets somewhat similar to this.

If you live in a large city, perhaps you can tell just how your streets are named or numbered.

Distance North and South of the Equator (*Latitude*). — Places upon a globe are located in much this manner. For example, the equator, which extends around the earth midway between the poles, corresponds to the dividing street running east and west. The distance between the equator and the poles, on either side, is divided into ninety parts (Fig. 90), corresponding, we might say, to the blocks in a city. These, however, are each about sixty-nine miles wide and are called *degrees*, marked with the sign °.

FIG. 90.

The globe, showing the two hemispheres and some of the circles of latitude.

In making maps people think of a line, or a circle, extending around the earth sixty-nine miles north of the equator, and called a *circle of latitude*. Any point upon it is one degree (1°) north of the equator, or 1° *North Latitude* (abbreviated to N. Lat.). Similar lines are imagined 2°, 3°, and so on up to 90°, or to the north pole.

Since all points on any one of these circles are the same distance from the equator, and from the other circles of latitude, the lines are *parallel;* and on that account they are called *parallels of latitude*. See a globe.

The same plan is followed on the south side, places in that hemisphere being in *South Latitude* (S. Lat.).

If one finds that a certain place is on the 8th, or the 50th, or some other parallel north of the equator, he knows how far it is north of the equator. San Francisco is close to the 38th parallel, Chicago close to the 42d, and St. Paul on the 45th (Figs. 178 and 211). Knowing this, it is easy to see that Chicago is 4°, or about two hundred and seventy-six miles, farther north than San Francisco, while St. Paul is 3°, or over two hundred miles, farther north than Chicago.

Of course there are no marks *upon the earth* to show where these lines run, but they are of great use *on maps*, because they help us to locate places. Small maps and globes cannot well show the entire ninety parallels on each side of the equator, so that usually only every fifth or tenth one is drawn. Examine some maps (such as Figs. 95 and 178), to see which ones are given. Near what parallel do you live?

In speaking of the seasons (p. 34) it was stated that on June 21 the vertical rays of the sun reached farthest north. The part of the earth which they reach is $23\frac{1}{2}°$ north of the equator, and is marked on the maps by the Tropic of Cancer (Fig. 90). The Tropic of Capricorn is the same distance south of the equator (Fig. 90).

Knowing now the length of a degree, you can find the width of the tropical zone, both in degrees and in miles. What is it? New Orleans is just south of the 30th parallel N. Lat. How far is it from the tropical zone?

On the day that the vertical rays of the sun reach farthest north, the entire Arctic Circle is lighted by the sun at midnight. This circle is the same distance from the pole as the Tropic of Cancer from the equator, that is $23\frac{1}{2}°$. The Antarctic Circle is the same distance from the south pole.

From this it is evident that we can easily find the latitude of a given place by the help of these parallels, for *latitude is the distance north or south of the equator.*

East and West Distances on the Earth (*Longitude*[1]). — But how about distance east and west? It is twenty-five thousand miles around the earth at the equator, and some means must be found for telling on the map how far places are from each other in these directions.

Imaginary lines are used for this purpose, as before; but this time they extend north and south from pole to pole (Fig. 91), and are called *meridians*, or lines of *longitude.* In the case of the city it makes little difference what north and south street is chosen from which to number the others. It is only necessary that a certain one be *agreed upon.*

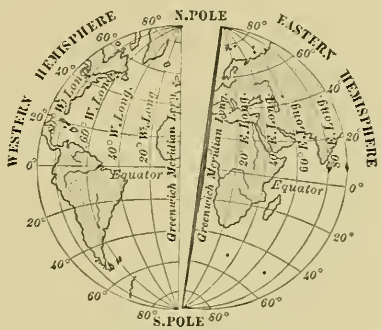


FIG. 91.

The earth, cut in halves along the Greenwich meridian, showing some of the meridians. The meridian 20° is usually considered the dividing line between the eastern and western hemispheres.

It is the same with these meridians. No one is especially important, as the equator is, and consequently different nations have selected different lines to start from. In France the meridian extending through Paris is chosen, in England that through Greenwich near London, and in America the one passing through Washington is sometimes used. But it is im-

[1] The ancients thought that the world extended farther in an east and west than in a north and south direction. Therefore they called the east and west, or *long* direction, longitude; the north and south direction, latitude.

portant that all people agree on some one, so that all maps may be made alike. On that account many countries start their numbering with the meridian which passes through Greenwich. The maps in this book follow that plan.

In Greenwich is a building, called an observatory, in which there is a telescope for the study of the sun, moon, and stars. As these heavenly bodies are of great help in finding the latitude and longitude of places, Greenwich seemed to the English a fitting place from which to begin numbering their meridians.

FIG. 92.

A view, looking down on the north pole, to show how the meridians come to a point at the north pole. Notice that if the 0° meridian were continued it would unite with the meridian 180°.

Commencing with this meridian as 0° longitude, people measure off degrees both east and west of it, and think of lines as extending north and south toward the poles, as they do of circles of latitude running parallel to the equator. Thus there is a meridian 1° west, another 2°, a third 3°, etc. Going eastward, they number 1°, 2°, 3°, in the same way.

Any place on the 3d meridian west of Greenwich is said to be in 3° *West Longitude* (W. Long.); if on the 60th meridian, 60° W. Long. Any place on the 20th meridian east of Greenwich is in 20° *East Longitude* (E. Long.). New York is 74° W. Long., while San Francisco is about 123° W. Long. Jerusalem is about 35° E. Long.

Knowing the latitude and longitude of any place, it can, by the aid of a map, be as easily located as a house in a great city. For instance, Denver is about 40° N. Lat. and 105° W. Long. It is therefore far to the north and west of New Orleans, which is about 30° N. Lat. and 90° W. Long.

Find the latitude and longitude of some of the large cities on the map (Fig. 97). Notice also that only every fifth meridian is marked. Compare this with the map of New England (Fig. 99). Since this map represents a smaller section of country, more meridians can be drawn upon it.

The circles of latitude are parallel to the equator and to each other, as you can prove by measuring the distance between them on a globe. But the meridians cannot be parallel on a globe, since they start from the poles and spread farther and farther apart until the equator is reached. Examine some of the maps in this book to see that the meridians are not parallel, while the lines of latitude are.

FIG. 93.

An orange with a part of the peeling removed to show how the lines converge toward the poles, as the meridians converge on the globe.

You can see how this is by taking the peeling from an orange (Fig. 93). The edges of each of the quarters spread far apart in the middle, or equator, but come together at the ends, or poles, of the orange.

A degree of longitude is a little over sixty-nine miles at the equator; but it decreases more and more as the poles are approached, until at the poles it is nothing, because all the meridians meet there at one point. Examine Figure 92 or, better still, a globe, to see that this must be true.

Standard Time

If you were to travel from New York to San Francisco, you would find on arriving there that your watch was three hours ahead of the clocks in that city. The reason is that the rotation of the earth, from west to east, causes the sun's rays to fall upon the Atlantic coast more than three hours sooner than upon the Pacific, so that when it is noon in New York, it is about nine o'clock in the morning at San Francisco.

Measuring from east to west, every place has a different time by the sun, and some years ago each city had its own *sun* or *solar* time. But when railways were built, connecting many places, these differences became a source of constant annoyance to the traveller. As his watch showed the time of only one place, perhaps a city some distance to the east or west, he could not tell exactly when a train would leave, or when his meals would be served.

In order to avoid all this trouble the continent has been divided into belts, in each of which all the railways, and most of the towns, have the same time. Since this time is the *standard for all*, these belts are called the *Standard Time Belts*. The one in the extreme east is called the *Colonial Belt;* that next west of it, which includes New England, New York, and some of the other Eastern states, is called the *Eastern Time Belt*. What are the names of the others? (Fig. 94.)

In travelling across the country from New York to San Francisco, one starts with his watch set at the standard time for the Eastern Time Belt. After a while he comes to a place where the time changes one full hour; then he has Central Time. Going still farther west to the Mountain Belt, the watch is again set back one full hour ; what is done when the Pacific Belt is reached? In this way, only a few changes of the watch have to be made ; and, as long as one remains in a certain belt, he is sure of the time of day.

Our study of longitude helps us to understand what determines the places for changing this time. When the

STANDARD TIME IN THE UNITED STATES.

Fig. 94.

To show the standard time belts of the United States, — the actual boundaries being irregular, as you see.

sun is rising at a certain point on a meridian, it is rising at every other point on that meridian.[1]

The earth makes one complete rotation every 24 hours, so that sunrise, noon, and sunset reach each of the 360 meridians in the course of the day of 24 hours. Dividing 360 by 24 gives 15; that is the number of meridians that

[1] It is understood, of course, that this does not apply to the frigid zone, where the sun does not rise at all during a part of the year, and where it does not set during another part of the year.

the sunrise or sunset pass over in a single hour. Therefore, if in one place, as at Philadelphia, on the 75th meridian, it is sunrise at six o'clock, it will be sunrise one hour later at all points just 15° west of this, or on the 90th meridian.

This explains what has determined the boundary lines of the time belts. The time selected for the Eastern Belt is that of the 75th meridian ; for the Central Belt, that of the 90th meridian, which is just one hour later. What meridian is selected for the Mountain Belt? (Fig. 94.) For the Pacific Belt? Each of these meridians runs through the *middle* of the belt whose time it fixes, so that the eastern boundary of the Central Time Belt is half-way between the 75th and 90th meridians, that is West Longitude $82\frac{1}{2}°$; and the western boundary is half-way between the 90th and 105th meridians, or $97\frac{1}{2}°$ West Longitude.

In reality the railways do not change their time *exactly* according to these boundaries, for oftentimes the meridians extend through very unimportant points, or even cross the railways far out in open country. Instead of following the exact boundaries, they select well-known places, like Buffalo, Pittsburg, and Atlanta, at which cities the change is made from Eastern to Central time. Therefore, the boundaries which represent the places where the railways *actually* change their time are somewhat irregular, and not always on the proper meridian (Fig. 94).

You see that the object of these Time Belts is to save annoyance, and that *for most places the standard time is incorrect time.* For instance, noon by the standard time is not the real noon for any places in the United States excepting those along the 75th, 90th, 105th and 120th meridians.

QUESTIONS: *Latitude and Longitude.* — (1) How may an east and west street be used in a city to locate houses? (2) How may a north and south street be so used? (3) Make a plan of a city showing two central streets and others numbered from them. (4) What corresponds to the central east and west street in locating places upon the globe? (5) Into how many parts is the distance between the equator and each pole divided? (6) What is each of them called? (7) What is meant by saying that a place is in 1° N. Lat.? (8) How far apart are the circles of latitude? (9) Why are these circles called parallels? (10) What is S. Lat.? (11) Give the latitude of each of the tropics. (12) Of the Arctic and Antarctic circles. (13) What is a meridian? (14) Why is it necessary to have them upon maps? (15) Which meridian is most commonly chosen as zero? Why that one? (16) How high do the numbers of the meridians run? (Fig. 360.) (17) What is meant by saying that a place is in 3° E. Long.? In 90° W. Long.? (18) Show that meridians are not parallel.

Standard Time. — (19) Explain why the time is continually changing as one goes west. As he goes east. (20) How has this caused annoyance in travelling? (21) What remedy has been found? (22) What are the names of the Standard Time Belts in the United States? (23) What is the difference in time between the belts? (24) Which meridians are used to fix the boundaries? Why these? (25) Show the boundaries on the map (Fig. 94). (26) Why is standard time really incorrect for most places?

SUGGESTIONS. — (1) Find how the streets of Washington have been numbered and lettered. (2) What is the width, in degrees and miles, of the north temperate zone? (3) What is the latitude and longitude of Boston? Of Washington? Of Chicago? Of your nearest large city? (4) Find some cities that are on or near the 42d parallel of latitude. (5) What place is in 25° N. Lat. and 81° W. Long.? Near 40° N. Lat. and 75° W. Long.? (6) Make a drawing showing several of the meridians. (7) Visit a telescope and look through it. (8) Find the 100th meridian (on map Fig. 97) west of which much of the country is arid. (9) Compare some of the parallels of latitude with the nearest isotherm (Fig. 63). (10) Where and how much would you change your watch in travelling from San Francisco to Chicago? (11) What is the difference in time between Baltimore and Denver? (12) Examine some railway time-tables to see how they indicate the changes in time. (13) What is the difference where you live between Standard Time and solar time?

GENERAL GEOGRAPHY

I. THE EARTH AS A PLANET

Stars and Planets. — As we look into the heavens at night, thousands of stars meet our gaze, and by the help of powerful telescopes many more thousands have been discovered. The stars are fiery hot bodies like the sun, but so far away that they appear only as twinkling lights.

Some impression of the immensity of the universe is gained when we reflect that some of the stars are so distant that their light, which is now reaching our eyes, may have started toward us as long ago as the time of Christ. Yet light travels so rapidly that it takes less than nine minutes for it to pass over the 93,000,000 miles that separate us from the sun.

Some of the brightest of the heavenly bodies have no light of their own, but, like the moon, merely reflect light that falls upon them from the sun. They do not remain in one part of the heavens, as the true stars do, but slowly change their position. For this reason they were long ago called *planets*, which means wanderers.

The planets are much nearer to us than the myriads of stars; in fact, they are members of the solar family to which the earth belongs. The sun is the centre of this family, or *solar system*, and supplies the members of it with light and heat. The eight large planets, named in the order of their distance from the sun, are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune.

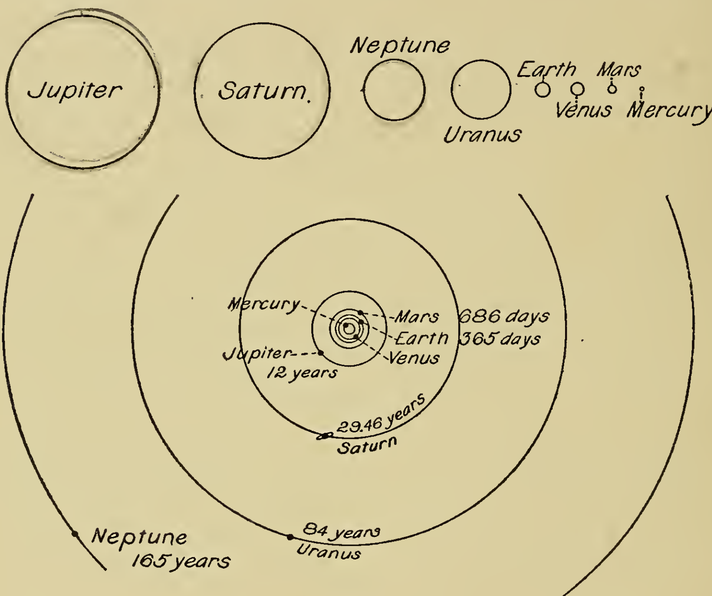


Fig. 1.

The circles at the top show the relative size of the planets; the lower figure shows their relative distances from the sun.

The two most distant of the planets cannot be seen without a telescope; but the others are easily seen, and Venus is the most brilliant object in the heavens, after the sun and moon. It appears either as the Evening Star or Morning Star. Find some of the planets in the sky.

There is a very close resemblance among the members of this solar family. All are spherical in form, and each one, whose movements are known, rotates upon an axis while revolving about the sun; but the periods required to complete their revolutions vary greatly with different planets. For example, Mercury, about 36,000,000 miles from the sun, takes less than three months for one journey around it; while Neptune, about 2,700,000,000 miles distant, requires 165 years for a single revolution. How far is the earth from the sun, and how long does it take for one revolution?

Ocean Basins and Continents. — It is believed that all of the planets were once hot bodies like the sun and the

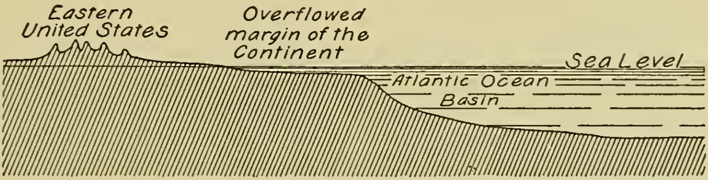


FIG. 2.

To illustrate the fact that the oceans fill the great depressions in the earth's crust that lie between the continent upfolds.

stars. The larger planets have not cooled as much as the earth, and some of them seem still to be hot. For example, the atmosphere of Jupiter is always full of clouds, as if the heat of the planet caused the ocean water to rise as steam. On the other hand, Mercury, Mars, Venus, and the Earth (Fig. 1), being so much smaller, have of course cooled more quickly. They have therefore become solid, and a cold "crust" of minerals and rocks has formed around the still heated interior.

You will recall that, as the interior of the earth continues to cool and contract, the crust settles upon it and is thus thrown into folds and wrinkles. It is these great upfolds that form the continents, while the downfolds form the ocean basins.

Water fills the extensive, depressed portions of the earth's surface, and even overflows the lower margin of the elevated areas (Fig. 2). Thus only about one-fourth of the earth's surface rises above the water. In which hemisphere is most of the land? (Fig. 3.) In which is most of the water? Locate the five oceans on a globe.[1]

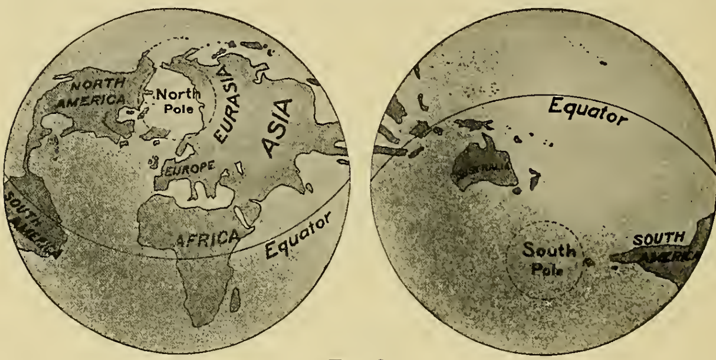


FIG. 3.

The land and water hemispheres.

While a broad ocean encircles the south polar region, land surrounds the north pole, extending southward in two great masses that are almost united at Bering Strait. The smaller of these, in the western hemisphere, includes North and South America, the New World; while the much larger Old World includes the great continents of Eurasia and Africa. South of Asia, in the southern hemisphere, is Australia, also classed as a continent. Find each of these on a globe.

Compare the continents with each other and with the United States in size (see Tables just before Index). Three are tri-

[1] See also the two maps inserted just before the list of Books of Reference.

angular in shape with the apex of the triangle pointing southward, while Eurasia has its greatest extent from east to west. Compare them as to their regularity of outline. Tell what bodies of water separate each continent from the others.

Mountains and Volcanoes. — As the heated interior of the earth has contracted, it has not only thrown the surface into a few broad folds, forming continents and ocean basins, but here and there the crust has been crumpled into narrower folds, forming mountain ranges. During the growth of mountains the rocks are both folded and broken. Through the cracks thus formed melted rock sometimes rises in such quantities as to build lofty peaks or cones known as *volcanoes* (Fig. 4). From Cape Horn to Alaska there is an almost unbroken series of mountain systems, among whose peaks are many volcanoes, some of which are still in action.

Fig. 4.

Mount St. Helens, Washington, a volcanic cone north of Portland, Oregon (copyrighted, 1899, by H. A. Hale).

Name the western ranges of North and South America, and such volcanoes of North America as you remember. Some of these mountain ranges are still rising, especially in South America, where within the last century the land in some places has been uplifted several feet. This rising of the land has been accompanied by destructive earthquake shocks caused by the slipping of the rocks as they moved one upon another.

A great girdle of mountains and volcanoes borders the Pacific (Fig. 5), reaching from Cape Horn to Alaska, and thence to the Kurile Islands by the way of the Aleutian chain. It then continues southward along the Japanese Islands to the Philippines and the East Indies, all of which are

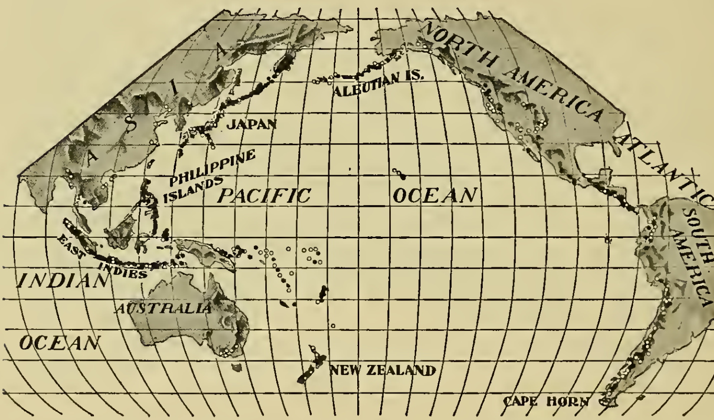


Fig. 5.

The girdle of mountains and volcanoes encircling the Pacific Ocean. Extinct volcanoes shown by circles, others by black dots.

mountainous islands where elevation is still in progress and where active volcanoes abound.

There are other mountain ranges and associated plateaus on each of the continents to be studied about later. Just now it is important to speak of but one other series of mountain folds, and these extend nearly east and west, while the mountains of the girdle just mentioned reach for the most part in a north and south direction. The east and west series includes the mountain systems of Eurasia, among which are the lofty ranges of central and southern Asia. These ranges reach their greatest elevation in the Himalayas on the southern border of the plateau of Tibet. Here are the loftiest mountains of the world. Other mountain chains of this series are situated much farther west, among the highest being the Caucasus, Alps, and Pyrenees in Europe.

Review Questions. — (1) What is a star? — (2) Give some idea of the distance of the stars from us. (3) What is a planet? (4) Name the eight planets. (5) Mention some points of similarity among them. (6) Of difference. (7) How has the earth's crust been formed, with its continents and ocean basins? (8) What is the extent and position of the water surface. (9) Describe each of the five oceans. (10) Similarly describe the land surface. (11) Tell about the girdle of mountains and volcanoes which encircles the Pacific. (12) Name and locate some of the mountain systems which extend east and west.

Suggestions. — (1) Find the north star. (2) Find some of the constellations. (The Great Dipper and Cassiopeia are always in sight at the north, and the Pleiades and Orion may be seen in the east on autumn evenings.) (3) Write out the observations you have made about the moon. (4) Make a careful sketch of Venus or Jupiter and the stars near them. After some days or weeks make a similar drawing and compare the two. (5) What might be some of the effects if the earth's revolution about the sun required a much longer period? (6) What changes might result if there were less water in the ocean depressions? (Think of effects on size of continents; on commerce; on climate; and on land adapted to agriculture.) (7) State some of the changes that would result if there were enough water to raise the level of the sea a thousand feet. (8) Draw a map of the Pacific Ocean, and with colored pencil, or ink, draw lines to show the surrounding mountain ranges of the continents and the island chains (Fig. 5).

Books of Reference for each Section are Listed at the End of the Book.

II. MOVEMENTS OF THE EARTH AND THEIR RESULTS

Daily Motion. — Like the other planets the earth is rapidly rotating, that is, turning on one of its diameters, called the *axis*. When we glance out of the window of a moving car, the objects we pass appear to be moving in the direction opposite to that in which we are travelling. It seems as though we were standing still. In a similar way the rotation of the earth makes the sun *appear* to rise and set, and for a long time people believed that it was the sun that moved, and not the earth.

In what direction must the earth rotate, since the sun appears to move from east to west? The period of time required for one rotation is called a *day*. Since the circumference of the earth at the equator is about twenty-five thousand miles, how far does a point on the equator move in an hour? In a minute?

By rotating a globe or an apple in the sunlight show how day and night are caused on the earth. Hold the sphere still; what would be true on opposite sides of the earth if it did not rotate at all? What might be the effect upon life on the earth if the same side were always toward the sun?

Yearly Motion. — While the earth makes one complete rotation in a day, it requires a whole *year* to make one journey, or *revolution*, around the sun. As the earth travels along its path, the stars on one side of the sun are visible on July evenings, and quite different stars and constellations on January evenings.

But this change in the appearance of stars is much less noticeable than the changes in the seasons, which are also due in part to the earth's revolution around the sun. If one part of our planet, as for instance the north pole, or the equator, or the south pole, were always turned toward the sun, revolution would not cause changes of season. As a matter of fact, however, the portion of the earth which is turned toward the sun is continually changing.

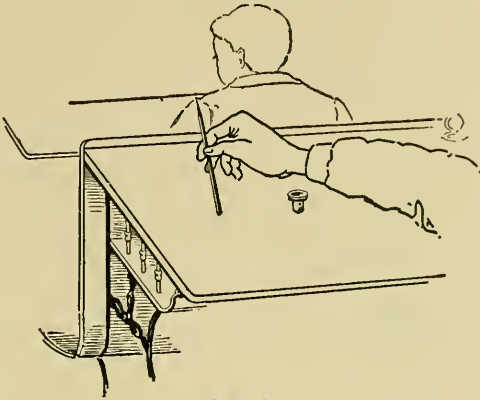


Fig. 6.

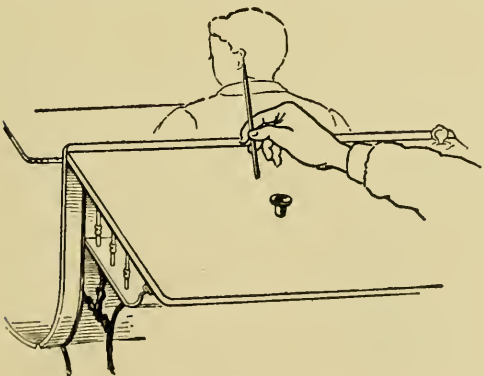


Fig. 7.

Place an ink bottle upon your desk. Then rest the blunt end of your pencil upon the table a few inches to the left of the bottle, with the pointed end inclined from you (Fig. 6). Notice that neither end of the pencil is now inclined toward or away from the bottle.

Now, keeping the pointed end inclined from you, always in the same direction, slowly move the pencil away from you in a circle around the bottle. When the side farthest from you is reached, the blunt end of the pencil is toward the bottle, while the point is turned away (Fig. 7). On reaching the right side, the two ends are again so placed that neither is turned from the bottle (Fig. 8); but on arriving at the side nearest to you, the pencil point is inclined toward the bottle, while the blunt end is turned away (Fig. 9).

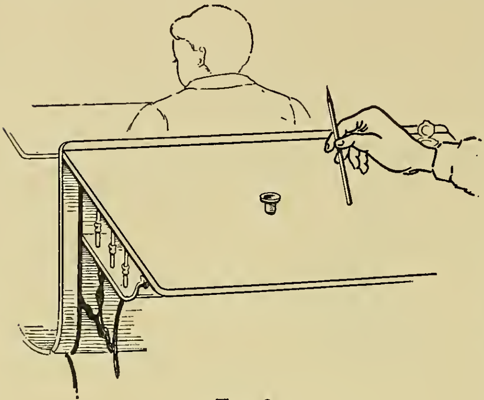


Fig. 8.

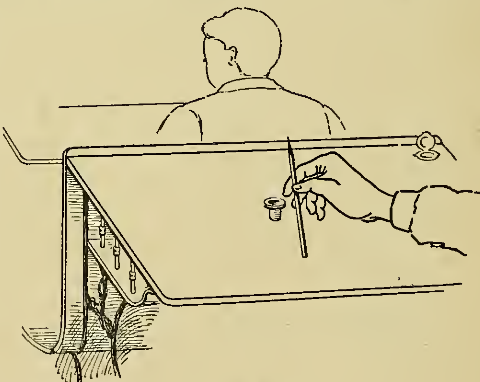


Fig. 9.

These positions of the pencil well illustrate those of the earth's axis with relation to the sun. The bottle represents the sun; the circular path followed by the pencil represents the *earth's orbit* or the slightly elliptical path taken by the earth in its journey about the sun; and the pencil stands for the earth's axis. The pencil, instead of being perpendicular to the surface of the desk, was somewhat inclined; and the earth's axis is also inclined to the plane through which the earth revolves, or *the plane of the orbit* (Fig. 10). The axis of the earth remains in this one position, pointing toward the north star.

Results of the Earth's Revolution and Inclination of its Axis. — This fact of the unchanging inclination of its

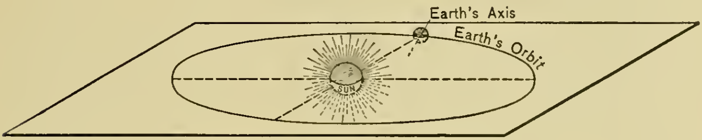


FIG. 10.

To illustrate the inclination of the earth's axis to the plane of its orbit.

axis, as the earth revolves about the sun, may seem a small thing in itself; but it is really of such momentous importance that hundreds of our customs are regulated by it. It determines the time when lamps shall be lighted, when grain shall be planted and harvested, and when the navigation of rivers and lakes shall open and close in cold climates. It also greatly influences the kind of clothing that we wear and the sports that we enjoy. Name some other of its influences. It does all this by continually changing the length of our day and the inclination at which the sun's rays reach the earth's surface.

Figure 11, showing the position of the earth on September 23, corresponds to the first position of the pencil (Fig. 6). Although the axis is inclined, neither pole is turned from the sun, and the light therefore extends from pole to pole. Then the sun's rays are vertical at the equator, and the days and nights are equal over all the earth. This time is called the *autumnal equinox* (the latter from two words meaning *equal* and *night*).

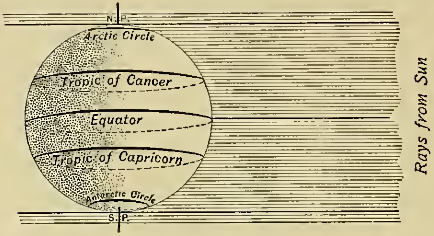


FIG. 11.

Position of the earth September 23. Notice that the vertical rays (heavy line in middle) are at the equator. Compare with Figure 6.

Figure 12 represents the earth in the second position of the pencil, or that of December 21, when the earth's revolution has brought the south polar region toward the sun and into the light, while the north polar region is shrouded in darkness. The vertical rays have now passed south to the *Tropic of Capricorn*. Examine a globe to see what countries are crossed by this line. Here the sun seems to turn and move northward, and for that reason this parallel is called a *tropic* (from a word meaning *to turn*).

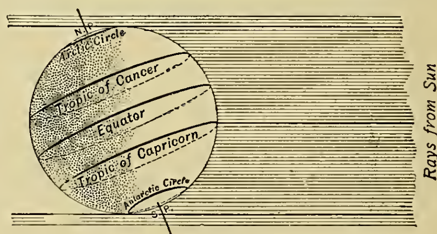


FIG. 12.

Position of the earth December 21. Where are the vertical rays now? What about the north pole? Compare with Figure 7.

When the sun is vertical over the Tropic of Capricorn, it is summer for lands south of this tropic, and the people of these lands have their longest day. Indeed, the south pole itself has been constantly in the sunlight for three months, and on December 21 the entire region within the Antarctic Circle has sunlight for the full twenty-four hours. On the other hand, we whose homes are in the northern hemisphere have our shortest day at this date, and winter is upon us. The north pole has been entirely without sunlight for three months, and the whole area within the Arctic Circle is in darkness even at midday. What is the condition of Europe then?

Figure 13 shows the third position, or that of March 21, when the poles are again turned neither toward nor away from the sun. The equator is once more under the vertical rays of the sun, and the days and nights are equal the world over. This period, called the *vernal equinox*, is the commencement of our spring. After this date our days gradually lengthen until, on June 21, the continued revolution of the earth has brought it into the fourth position (Fig. 9). The sun's rays are then vertical over the *Tropic of Cancer* (Fig. 14), and at this date we have our longest day, and summer is upon us.

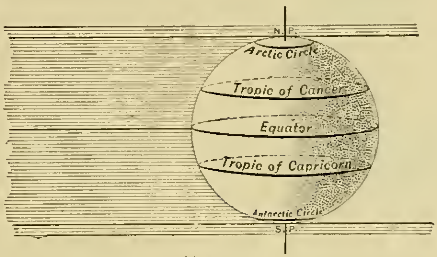


FIG. 13.

Position of the earth March 21. Where are the rays vertical? Compare with Figure 8.

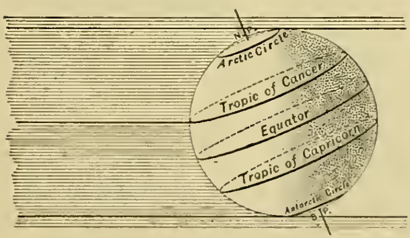


FIG. 14.

Position of the earth June 21. Compare with Figure 9.

What countries of the northern continents are then warmed by the vertical rays of the sun? (See a globe or map.) The

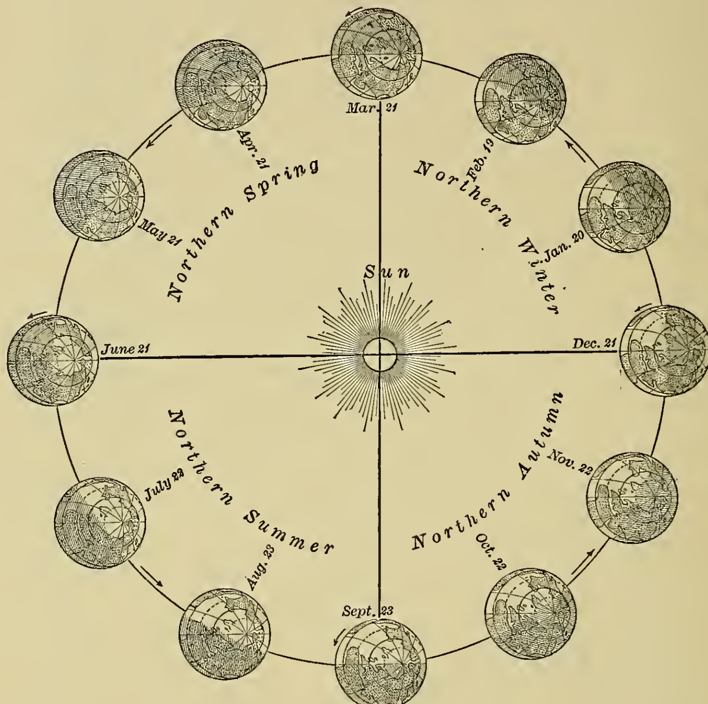


FIG. 15.

To illustrate the revolution of the earth around the sun. The shaded portion represents night. The end of the axis around which the earth rotates is the point where the lines come together (the north pole). At what date is this pole turned toward the sun? Away from it? Neither toward nor away from it? What portions of the earth do the sun's rays reach at each of these times?

Arctic region is in the midst of its longest day and summer, while the Antarctic is wrapped in the darkness of its long winter night. Why? In what direction from us does the sun rise and set at this time?

After this the sun again seems to turn, this time moving southward. Year after year, as the earth revolves around the sun, exactly these changes take place.

Boundaries of the Zones. — The *amount* of inclination of the earth's axis has not been stated, but you have no doubt discovered that that is a matter of very great importance.

In considering the amount, it is necessary to speak of angles. Angles may be measured by the use of circles. A right angle, for instance, is one that includes one-fourth of a circle between its sides (Fig. 16). It is customary to divide circles into parts, or *degrees* (indicated by the sign °), the number chosen being 360, a number which is exactly divisible by numerous other numbers, as 2, 3, 4, 5, 6, 8, 9, 10, 12, etc. Since a right angle includes one-fourth of a circle, it contains one-fourth of 360°, or 90°; and an angle that is one-half as large as a right angle contains 45°. By drawing lines from the centre of a circle to its circumference, construct an angle of 90°; and others of 120°, 45°, and $22\frac{1}{2}$°

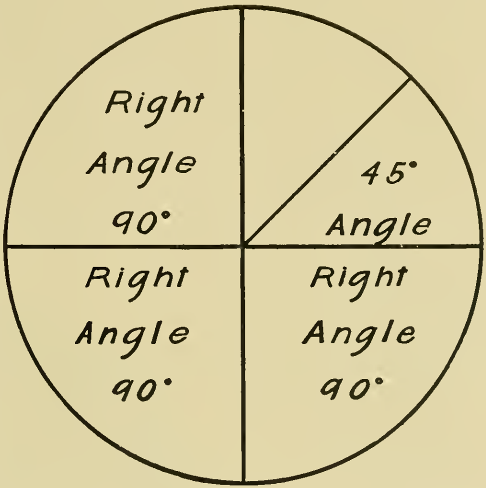


FIG. 16.
To illustrate the meaning of angles.

The angle in Figure 17 is $23\frac{1}{2}$°, and shows just how far the pencil (Figs. 6–9) should be inclined. Hold your pencil perpendicular to the top of the table; now tilt it about $23\frac{1}{2}°$. That is the position of the earth's axis with reference to the plane of its orbit, and year after year it remains at that angle.

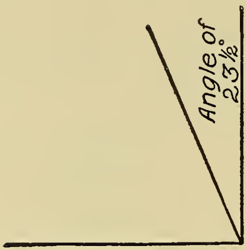


Fig. 17.

An angle of $23\frac{1}{2}°$ drawn in a right angle.

This is the reason why the tropics and polar circles are situated just where they are. On June 21, when the north pole is turned toward the sun, the vertical rays fall $23\frac{1}{2}°$ north of the equator, because the axis is inclined that amount. On that account the Tropic of Cancer lies $23\frac{1}{2}°$ north of the equator. At this date, also, the sunlight reaches the same number of degrees beyond the north pole, and therefore the Arctic Circle is located $23\frac{1}{2}°$ from the pole.

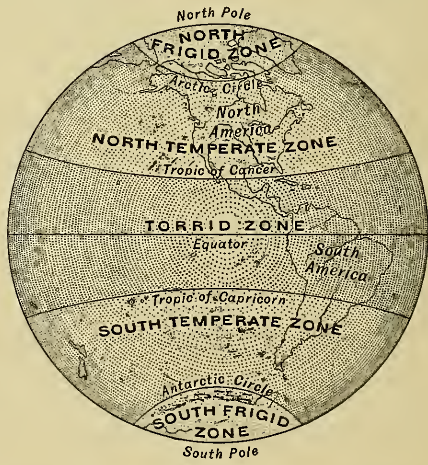


Fig. 18.

A map of the zones. Make a drawing similar to this.

On December 21 the earth's revolution has caused the north pole to turn away from the sun, and the vertical rays then fall $23\frac{1}{2}°$ south of the equator, while the sunlight reaches the same distance beyond the south pole. Thus the Tropic of Capricorn and the Antarctic Circle are located. It is plain, therefore, that the inclination of the earth's axis determines the exact boundaries of the zones.

Show each zone on a globe and point out its boundaries (Fig. 18). What is the width of each in degrees? Find the approximate width in miles. (Each of these degrees is about sixty-nine miles.) What is the direction of the sun's rays in each zone, and the resulting temperature? Should you expect to find a very different temperature in moving across the boundary line between two neighboring zones? Why?

Review Questions. — (1) What is the earth's axis? (2) What was formerly believed about the earth's movement? (3) In what direction does the earth rotate? (4) What changes in the stars result from the earth's revolution? (5) What other effect of revolution is noticeable? (6) With a pencil, illustrate the movement of the earth around the sun (Figs. 6–9). (7) What is the earth's orbit? (8) What is the plane of the earth's orbit? (9) How are we affected by these positions of the earth? (10) Describe the position of the earth, the length of day, etc., on September 23. (11) On December 21. (12) March 21. (13) June 21. (14) How may angles be measured? (15) Give examples. (16) How much is the axis of the earth inclined? (17) How does this inclination of the earth's axis serve to fix the boundaries of the zones?

Suggestions. — (1) Find out why the earth is slightly flattened at the poles. (2) What might be some of the effects if each rotation lasted longer than twenty-four hours? (3) If much less? (4) At what time of day does your shadow always point directly north? (5) Notice how your shadow changes with the season in early morning. At noon. In the evening. (6) Tell about the direction and length of a man's shadow at noon on December 21st, at various points between the poles. (7) On June 21. (8) On September 23. (9) How long is our longest night? Our shortest? (10) Make a sketch of the eastern and western horizons as seen from your home. On it locate the position of the rising and setting sun at different times of year. (11) Which zone experiences the slightest change of seasons? Why? (12) What advantages and disadvantages do you see in that fact for people living there? (13) Is it once or twice each year that the vertical rays of the sun fall upon any one place in the Torrid Zone? (14) What might be the effect of a greater inclination of the earth's axis? Of a less inclination?

III. MAPS. (LATITUDE AND LONGITUDE)

To aid in locating cities, lakes, and other points on the earth's surface two sets of circles are used, one extending east and west, the other north and south. When maps of any part of the earth's surface are made, these circles are drawn on them. In a study of the earth they are of much the same advantage as the names and numbers of streets when one is finding his way in a large city.

Latitude. — The circles which are extended around the globe in east and west directions are called *circles of latitude* (Fig. 19). The two tropics and the Arctic and Antarctic circles are examples, and there are many others. In order that they may be of use they must be numbered. Accordingly, the *equator*, or the circle which is midway between the poles, is called 0° latitude. All circles north of this, that is all in the northern hemisphere, are said to be in north latitude; all south of it, or in the southern hemisphere, are in south latitude. Since these circles are parallel to each other, they are often called *parallels* of latitude.

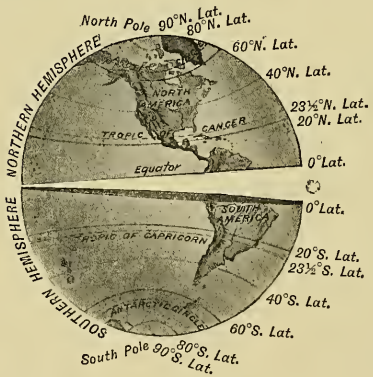


Fig. 19.

The globe, showing the two hemispheres and some of the circles of latitude.

It has been said (p. 15) that a circle may be divided into 360 parts, or degrees. One-fourth of 360 is 90; and since the distance from the equator to either pole is one-fourth of that around the earth, there are just 90° from the equator to either pole. Accordingly the circles of latitude in each hemisphere are numbered from 0° at the equator to 90° at the poles. Since the circumference of the earth is about 25,000 miles, dividing that by 360 makes the length of each degree of latitude about 69 miles. Therefore latitude is merely distance from the equator.

What cities in the United States are near the fortieth parallel of north latitude? What is the latitude of Key West? Of New York? Of Madrid in Spain? Of Peking? Of Kimberley in South Africa? Of the Tropic of Cancer? Of the Tropic of Capricorn? Of the Arctic Circle? Of the Antarctic Circle?

Longitude. — It is evident that the distance of any place north or south of the equator can be easily found by the use of circles of latitude. But of course there must be some means of locating points in east and west directions also. This is made possible by the use of *meridians*, or circles extending northward and southward across the equator.

Notice on Figure 21 how the meridians converge toward the poles, coming nearer and nearer together until they finally reach the poles. Since they meet at these two points, though spreading far apart at the equator, it is plain that they *cannot be parallel* (Fig. 20). Degrees of longitude, therefore, are not of the same length in all places. At the equator, which is 25,000 miles in length, each of the 360° is about 69 miles; but where the meridians cross the smaller Arctic Circle, the length of a degree of longitude is much less.

To number the circles of longitude, a *prime* or *zero meridian* must be selected from which to commence. The one most commonly chosen for this purpose is that passing through Greenwich near London. All circles of longitude east of this meridian are numbered as *east longitude* (E. Long.) until the opposite side of the earth, or meridian 180°, is reached (Fig. 21). All west of the Greenwich meridian, as far as 180°, are numbered as *west longitude* (W. Long.).

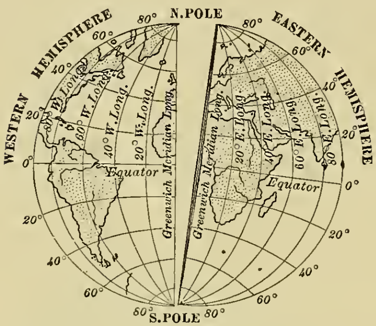


FIG. 20.

The earth, cut in halves along the Greenwich meridian, showing some of the meridians.

The 180th meridian is a continuation, on the other side of the earth, of the Greenwich or zero meridian, and the two together make a complete circle. Hence we may speak of *circles of longitude* as well as circles of latitude. Why must the meridian marked 180° E. Long. be the same as the one marked 180° W. Long.? Which meridian passes near New York? Denver? Vienna? Jerusalem?

Find the latitude and longitude of Chicago. Of New Orleans. St. Petersburg. Rome. Peking.

If a large map is made of a small part of the earth, the circles of latitude and longitude are too far apart to be of much use. Therefore, it is customary to divide each degree into sixty parts called *minutes,* just as each hour is divided into sixty parts. Each minute of latitude and longitude is divided into sixty parts called *seconds,* as each minute of time is divided into sixty seconds. The sign for a degree is °; for a minute ′; for a second ″. Thus 60 degrees, 40 minutes, and 20 seconds north latitude is marked 60° 40′ 20″ N. Lat. Examine some map of a small section to find these signs.

Longitude and Time. — The meridians are of use in determining time also. When it is noon at one point on a meridian it is noon at all other places along the same meridian. For example, when it is noon at your home, it is midday at all other places which are exactly north or south of you. Just one twenty-fourth of the distance around the world to your east, that is 15° east of you, it is exactly one hour later. What is true on your west?

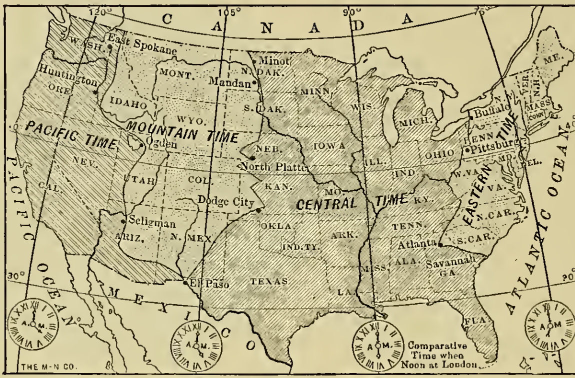
FIG. 21.

To show how the meridians converge at the pole. Trace the 0° meridian to the opposite side of the globe. What is it numbered there? Trace some of the others.

You will recall that the United States is divided into belts of Standard Time (Fig. 22), each belt having the time of its central meridian. These central meridians are taken 15° apart, so that the difference in time between adjoining belts is exactly one hour.

In order that the system may accord with that of other parts of the world, the time of the Greenwich meridian is taken as the basis. Thus the whole world, like the United States, may be divided into standard time belts, with a change of an hour at every fifteenth meridian.

Maps of the World. — When we wish to represent the earth accurately we must use a globe; but this involves so many inconveniences that geographers have invented other kinds of maps. However, the fact that the earth is a sphere makes it impossible to draw flat maps of large sections without some distortion. You can understand the difficulty if you try to flatten the half of a hollow



STANDARD TIME IN THE UNITED STATES.

FIG. 22.

Standard time belts of the United States. Find the central meridian for each time belt. Why are the actual boundaries of these belts so irregular?

rubber ball upon a table. You could not possibly do this without stretching it out of shape along the edges.

A *small* part of the earth is so nearly flat that it may be represented on a map without distortion, but when half of the whole earth is to be shown there is much distortion. For example, in a map of the hemispheres (Fig. 20) you can easily see that the meridian in the centre is shorter than those on the outside; but on a globe all the meridians are of the same length, since all reach from the equator to the poles. On such a map, therefore, lands at the edge must be represented as longer from north to south than those near the central meridian.

A map of the whole earth, like Figure 25, is called a

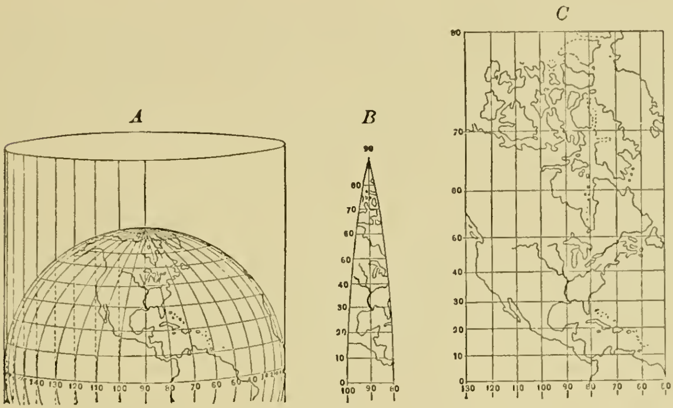


Fig. 23.

To illustrate the distortion on Mercator maps. *A* shows a globe with the meridians converging at the pole. *B* shows three of these meridians coming to a point at the north pole, as they do on a globe. For a Mercator map these meridians are spread apart and made parallel as they would be on a cylinder (a cylinder is drawn around the globe in *A*) rolled out flat, as in *C*. This, of course, distorts the lands, making them too broad in the north. Compare *A*, *B*, and *C*, to understand that this is so. Notice, also, that the parallels of latitude are drawn farther apart toward the north.

Mercator map, after the man who first made one. It is drawn as though the lands and waters near the poles were stretched out until the meridians are parallel. At the same time all the parallels of latitude are made as long as the equator. (See Fig. 23.)

In a Mercator map, the farther you go from the equator, the more the lands are distorted. Greenland, for instance, and northern North America and Eurasia, are greatly exaggerated in breadth. Also the Arctic Ocean looks like a long extent of water, instead of a great gulf opening from the Atlantic, which it really is. On such a map the poles themselves cannot be shown at all.

There are other ways of representing a part or all of the earth. For example, see Figures 3 and 29. Compare the different maps of this book to see how the form of continents varies in those drawn after different plans. From these statements you can see how very important it is to use a globe frequently, in order to keep in mind the real shape of the continents.[1]

Review Questions. — (1) By what lines are places on the earth's surface accurately located? (2) How is latitude indicated on maps? What is latitude? (3) What is the starting point for measuring it? (4) What is the length of a degree of latitude? How is it determined? (5) How is longitude indicated? What is longitude? (6) What is the starting point for measuring it? (7) What is the length of a degree of longitude at the equator? Why? (8) How are the meridians numbered? (9) What subdivisions of degrees are there? Why are they necessary? (10) How does the time change in going eastward? Westward? (11) Tell about Standard Time in the United States. (12) Why is it difficult to make accurate maps of large parts of the earth? (13) In what way are hemisphere maps distorted? (14) Mercator maps?

Suggestions. — (1) Compare the latitude of the most southern point in the United States with the most southern point in Europe. (2) Compare the longitude of eastern United States with that of western South America. (3) Find some places that have nearly the same latitude as your home. The same longitude. (4) Ask a surveyor to tell you the exact latitude and longitude of the city hall, or your town centre. (5) Show on a globe or map where a ship would be in the Atlantic when in zero latitude and longitude. (6) What city is about 45° N. Lat. and 93° W. Long.? (7) What islands are nearly 14° N. Lat. and 145° E. Long.? (8) Since the sun's rays travel over 15° of longitude in an hour of time, how many minutes of longitude do they travel over in one minute of time?

[1] *Small* globes are so cheap that every school should have at least one.

IV. WIND AND RAIN BELTS

One great lesson of geography is that all nature is bound together. Each force influences others, and all of the forces together affect not only the plants and animals of the earth, but the life of man himself. For example, it is because of the earth's form and motions that the sun's heat is distributed in belts which change with the seasons. In turn these different zones of heat have determined the great belts of winds and the distribution of rainfall. If we would clearly understand life conditions upon the different continents, we must know about these belts of wind and rain.

Winds

Cause of Winds. — The principal cause of winds is illustrated every time a fire is kindled. The flame warms the air and causes it to expand and grow lighter. This lighter air is then forced to rise by the pressure of the colder, heavier air round about, which pushes in underneath, and, by crowding the warm air upward, produces a draught. So long as the fire burns, this movement is kept up.

The winds of the globe are produced in a similar manner. Whenever the air is cooler in one place than in neighboring regions, the cool, heavy air settles down, flows beneath the warmer air and slowly raises it. Then the warm air, which has been lifted, flows out and away at a higher altitude. Thus, either in the case of a gentle breeze or of a violent hurricane, we may think of *four* directions of movement of the air. Illustrate them by a drawing.

The Wind Belts. — So long as the vertical rays of the sun produce a heated belt near the equator, with cooler air to the north and south where the rays are slanting, there must be an extensive system of winds on the earth. From the cooler regions on the two sides, the air flows steadily toward the central part of the heated belt, producing the *trade winds* (Figs. 24 and 25). As the trade winds approach the central line of the heated belt, or the

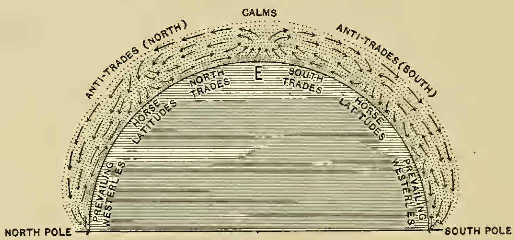


FIG. 24.

Diagram to show, by arrows, the movement of the greater winds of the earth.

heat equator, they travel more slowly. Then, owing to expansion from heat, and to pressure from the colder air behind, the air rises over a broad area to a great height. In this belt of rising air, whatever winds are felt are light and changeable, and calms often prevail; hence the name *belt of calms*.

At an elevation of several thousand feet this air flows outward, above the trade winds, toward the poles, producing the *anti-trades* (Fig. 24). About a third of the distance to the poles, near latitude 30°, much of the air of the anti-trades settles to the earth again, near the place where the

FIG. 25.

A diagram to show the principal wind belts of the earth.

trade winds begin. Since the movement of the air here is downward, there can of course be little wind in this belt, which is known as the *horse latitudes* (Figs. 24 and 25).

If the earth did not rotate, the trades and antitrades would no doubt follow the meridians directly toward and away from the equator; but rotation turns them from their course, to the *right* in the northern hemisphere, and to the *left* in the southern. Thus the trade winds blow from the northeast and the southeast, while the anti-trades return in the opposite directions at higher altitudes.

Beyond the horse latitudes much of the air of the anti-trades flows on toward the poles as westerly winds, both high in the heavens and at the surface. Travelling onward, and coming into smaller and smaller space as the poles are approached, portions of the air continue to turn back toward the equator, while the remainder sweeps on as westerly winds. These are plainly felt in the United States, Canada, northern and central Europe, and over the great Southern Ocean; and since the *prevailing* winds over these vast areas are from the west, these belts are known as the regions of *prevailing westerlies* (Fig. 25).

The great wind and calm belts that encircle the earth are not always in exactly the same place. As the vertical rays of the sun move north and south from tropic to tropic, the zone of greatest heat must follow. So the belts of heat, and therefore of winds (Figs. 31 and 32), change their positions every year, shifting northward in summer and southward in winter.

Rain

Causes for Rain. — Knowing the wind belts that encircle the earth, we have a key to the principal rain belts;

for winds are the water carriers of the earth. Water which is evaporated from the surface of the oceans and lands, is borne along in the air. As rain or snow it descends to the earth, abundantly along most coasts, and, usually, less liberally toward the interior of the continents.

It is an important fact that there can be more water vapor in warm than in cool air. Therefore, whenever air is cooled sufficiently some of the water vapor which it bears is condensed. For example, vapor condenses on an ice-water pitcher because the air next it is cooled; and dew forms on grass when the air near the ground grows cool in the evening. In a like manner the vapor in our breath forms a little cloud when the breath in winter is cooled by mixture with the cold outside air.

Rain is usually caused by the cooling of air which is rising to higher levels and therefore expanding. When you open the valve of a bicycle tire, the outrushing air expands and grows cool; and if you place your finger over the valve, you can feel the coolness. In a similar way, when air rises above the surface of the earth it expands because there is less air above to press upon it. Then it grows cool; and while doing so some of its vapor may be condensed to form clouds and raindrops. So whenever air from the damp oceans is rising over highlands, or whenever it is being raised over warm lands by the cooler air that pushes underneath, as in the belt of calms, rainfall naturally results. Briefly, — *when air rises, it expands and cools; and then rain commonly follows.*

On the other hand, air that is settling grows warmer, and instead of giving up its vapor, it becomes dry and clear. This may again be illustrated by reference to the

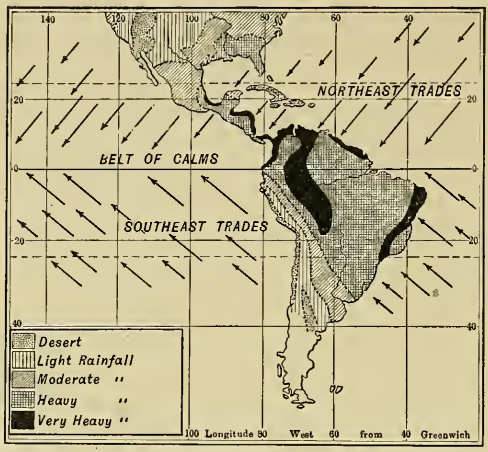


FIG. 26.

The rainy belt of calms of South America. Also the rainy east coasts and arid west coasts of the trade-wind belts.

bicycle; for when air is pumped into the tire, the pump becomes warm as the air is compressed. In a like manner, air that is descending toward the earth's surface is compressed and warmed because of the increasing pressure of the atmosphere above. Since there can be more vapor in warm than in cool air, when air flows down the mountain slopes, or descends from high altitudes, as in the horse latitudes, clouds disappear and water is evaporated from the

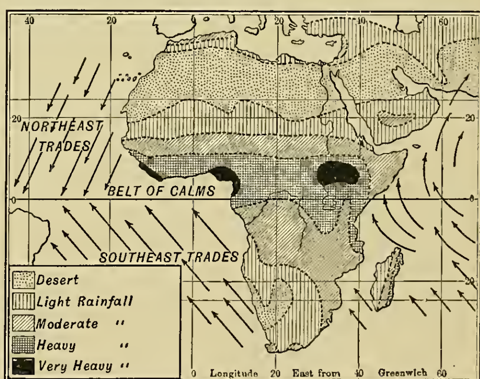


FIG. 27.

To illustrate the desert regions in the trade-wind and horse latitude belts of Africa. Also to show the heavy rainfall in the belt of calms. Find the similar belts on Figures 26, 28, and 30.

ground. Briefly, — *when air descends, it becomes denser and grows warmer; then the sky is clear and the weather dry.*

Rain Belts. — The belt of calms is the most rainy belt of the earth (see Figs. 26, 27, and 28), because its hot, moisture-laden air is rising and cooling. After a clear night in that region, the sun usually rises in a cloudless sky. As the morning advances and the heat grows more intense, the damp air rises more rapidly; then small clouds appear and grow steadily until rain falls from them. Showers occur practically every day, increasing in the afternoon. When the sun sets and the air rises less actively, the clouds melt away, the stars appear, and the night is as clear as before. Our hot, muggy summer days, with heavy thunder showers in the afternoon and evening, illustrate the weather that is repeated day after day in this belt of calms.

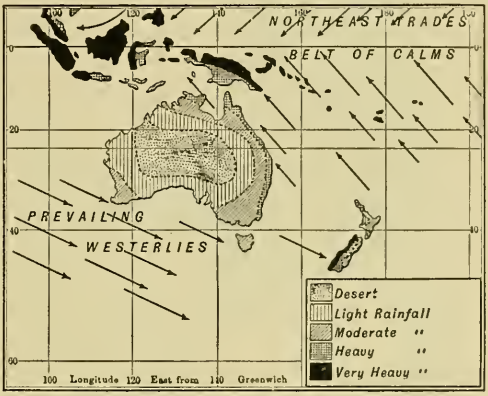


FIG. 28.

Showing the heavy rainfall on the east-facing coast of Australia where the trade winds blow. Notice also the arid interior and west coast. What is the condition in the belt of calms? What resemblance do you see to Figure 30?

Since the trade winds blow from cooler to warmer regions, and are therefore steadily growing warmer, their air tends to take up moisture rather than to drop it. The

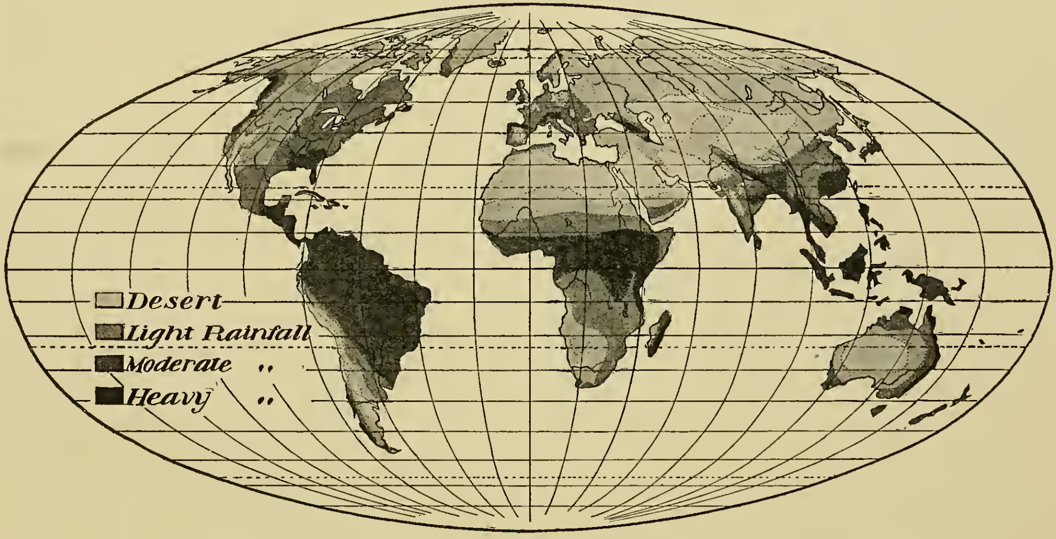


Fig. 29.

A rainfall map of the world. In which of the wind belts (see Fig. 25) do we find the heaviest rainfall? On which coasts? Where are the deserts? Explain the location of those on each continent. Why should there be more desert in Africa than in South America?

trades commence on the edge of the horse latitudes, where the descending air is also growing warmer and evaporating moisture. Thus both north and south of the rainy belt of calms there is a belt of little rainfall. Within these belts are the Sahara and most of the other desert regions of the earth. Point them out in Figures 26, 27,

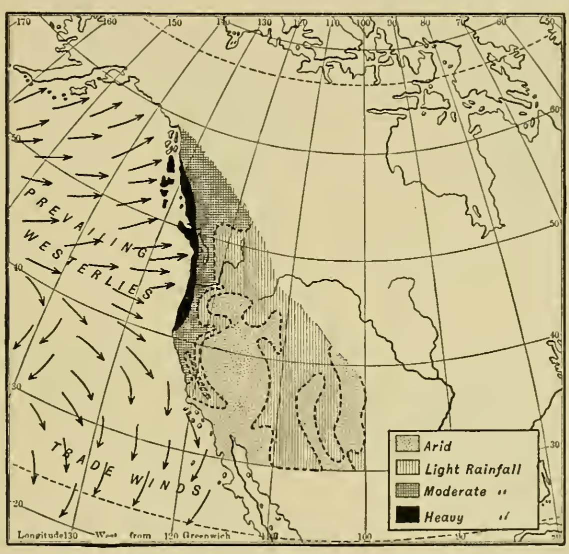


FIG. 30.

The heavy rainfall where the prevailing westerlies blow over the rising coast. What is the condition farther east? What is the case where the trade winds blow? Why?

and 28. Which of our Pacific Coast States is partly in the horse latitudes? (Fig. 30.)

Although the trades are *drying* winds, they obtain much vapor when they pass over the ocean. Therefore, wherever they blow from the ocean upon the rising slopes of the land, and especially upon mountain slopes, the moist air is cooled in rising, and abundant rain falls. Owing to this, the eastern or *windward* slopes of lands in the trade-wind belts have abundant rainfall, while the western or *leeward* slopes, and the level interiors of continents, have little. Notice how clearly this is shown on the rainfall maps (Figs. 26 to 30). What sections in North America are thus affected?

In the broad belts of westerly winds, where the air rises over western coasts and islands, there is heavy rainfall. Find examples in Figures 28 and 30. On the other hand, slopes further east, in the interior, receive little rainfall from such winds and may even be deserts (Fig. 30). Name some of our states that are thus made arid.

Migration of the Rainfall Belts. — Since the belts of heat, and therefore of winds, shift north and south each year (p. 28), many places have heavy rainfall at one season and dry air at another. In the torrid zone, for example, many places are within the belt of calms during the summer of their hemisphere, and are swept by the drying trades in their cooler months (Figs. 31 and 32), thus dividing the year into wet and dry seasons.

Monsoons. — We have thus far studied the great wind belts, and the rain belts that are dependent upon them. But in many regions these regular winds are greatly interfered with, and the rainfall must consequently be affected. One of the chief sources of such disturbance is the difference between the temperature of land and water.

Land warms and cools much more quickly than water. How hot the stones feel in summer compared with pond water! And how quickly the ground freezes in autumn, while we are still waiting for skating on the ponds! Likewise in summer the continents are warmer than the oceans; in winter, cooler.

Places in the interior of continents, far from the ocean. naturally have the greatest extremes of temperature. During the winter, the heavy air over the cold land settles

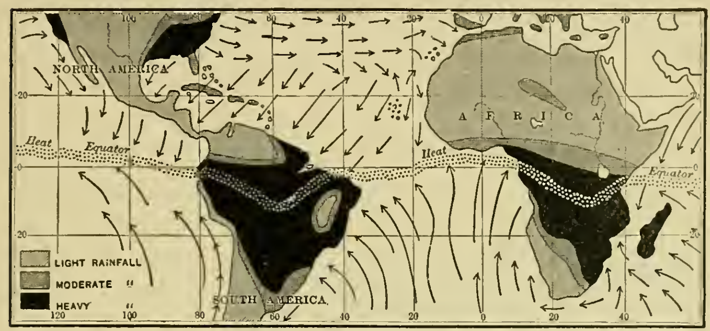


FIG. 31.
Winds and rainfall in South America and Africa from December to February.

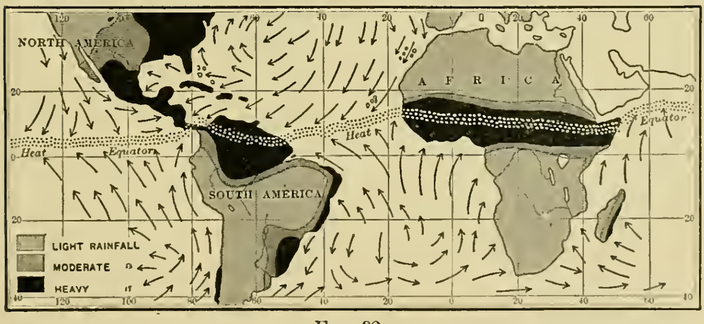


FIG. 32.
Winds and rainfall in South America and Africa from June to August. Compare with Figure 31 to see how the belts of heavy rain have migrated as the wind belts have shifted with the change of season.

down as drying air, and presses outward beneath the warmer air which lies over the oceans. This produces dry land winds. In summer, on the other hand, the air over the cool waters crowds in, raises the hot air of the continents, and produces ocean winds and rain. This is well illustrated in the southern part of Asia. Heated by the nearly vertical rays of the sun during the northern summer, the land there becomes warmer than the ocean. Toward this heated area the cooler air from over the Indian Ocean crowds in, causing ocean winds.

This makes the summer winds opposite in direction to those of winter when the air is flowing out toward the warmer Indian Ocean from the cold lands of interior Asia (Fig. 34). Winds of this kind, which blow in opposite directions in different seasons, are better developed in India than in any other part of the earth, and it was there that they received their name, *monsoon* winds. The term monsoon is now applied to inward-flowing summer winds and outward-flowing winter winds of any large mass of land.

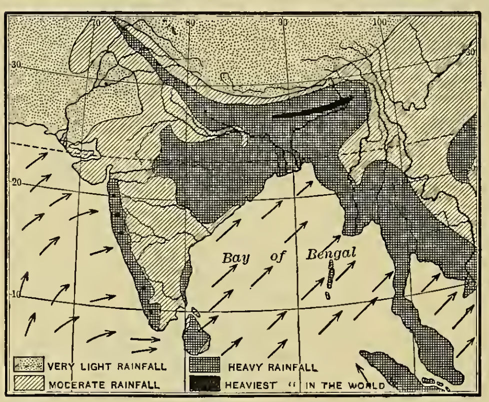


Fig. 33.

The winds and rainfall during the summer monsoon of India.

When the summer monsoons blow, the rainy season comes in India (Fig. 33). The rainfall is especially heavy where the moisture-laden air rises up the steep slope of the Himalayas. In one part of this district, opposite the head of the Bay of Bengal, there is three times as much rain in July alone as falls in well-watered portions of the United States during the entire year. The winter monsoon, on the other hand, is so dry that vegetation withers and the soil becomes parched and cracked, as in a desert (Fig. 34).

While the north and south temperate zones are both called *temperate*, and have many features in common, they are quite unlike in some respects. In the northern hemisphere the broad continents become very hot in summer and cold in winter. Since the temperature of the oceans remains more uniform, the regular winds are greatly interfered with, as by the monsoons. In the south temperate zone, on the other hand, there is little land and a vast expanse of ocean. The temperature of the water changes but little, and the narrow lands have their temperature largely determined by winds from the oceans. In the south temperate zone, therefore, there is little chance for winds between land and water to change the course of the westerly winds. Hence the west winds blow much more regularly there than in the northern hemisphere. Sailors call these inclement southern latitudes the "roaring forties," and shun

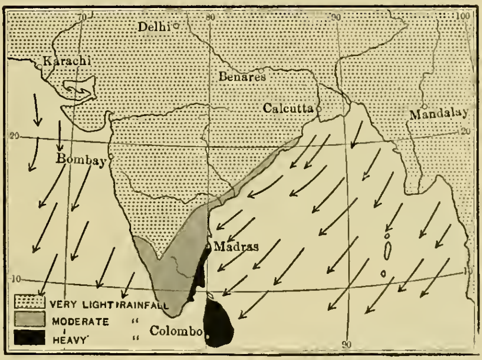


FIG. 34.

Map of the winter monsoon winds and rainfall of India. Compare with Figure 33, and notice especially how very light the rainfall is in one season and how heavy it is in the opposite season.

the stormy voyage around Cape Horn, where the west winds blow with wonderful steadiness.

Cyclonic Storms. — There is another great source of disturbance of the regular winds, which we studied about in the preceding book. It was learned there that in northern United States and southern Canada there appears, every few days, an *area of low pressure* where the air is lighter than that over the surrounding region. Toward such a low-pressure area heavier air from the surrounding country hurries, even from distances of hundreds of miles. Thus winds are caused which on the south side blow from the south, on the east side from the east, etc.

Fig. 35.

A cyclonic storm in Europe which came from the ocean. The heavy black line shows the course followed by its centre. Notice how the winds blow toward the centre.

Owing to the earth's rotation, these winds are turned from their straight course and therefore move spirally toward the centre of low pressure. On nearing this centre the air rises, and as it does so the vapor condenses, forming clouds and rain. Such great, whirling eddies of air, with their accompanying clouds and rain, are known as *cyclonic storms.* It is these that cause most of the rainfall of northeastern United States and Canada.

We learned further, that instead of remaining in one place, the cyclonic storms steadily travel onward, usually beginning in the northwest or southwest and *always* passing eastward. They generally follow the Great Lakes, pass down the St. Lawrence, and then out upon the ocean, which they frequently cross, even entering Europe. Indeed, they sometimes travel far into Asia before finally dying out.

Since the movement of their centre is always eastward, these storms are doubtless a part of the prevailing westerlies. But since they are composed of currents of air from all directions, they are a source of numerous disturbances in the lower layers of this great eastward drift of air. Indeed, they resemble eddies in a river, where the water of the eddies is whirling around in various directions, though the general current of the river is down stream.

In Europe and western Asia, as in America, the extent of the country upon which rain may be falling from the clouds of one of these storms is sometimes very great. Places hundreds of miles apart may be receiving rain at the same time. In Eurasia also, as in America, the weather is made changeable by these storms. That is, in any particular locality it may be warm and pleasant one day, stormy the next, then clear and cool or cold. Similar cyclonic storms develop in the prevailing westerly belt of the southern hemisphere, where they bring changes of weather to southern South America, Australia, and the islands of the great Southern Ocean.

Review Questions. — (1) Why should we study about winds? (2) Explain the cause of wind. (3) Explain the trade winds. (4) Tell about the belt of calms. Locate the belt. (5) Explain the anti-trade winds. (6) Where are the horse latitudes? How about the wind there? (7) What directions are taken by trades and anti-trades? Why? (8) What are the prevailing westerlies? Where felt? (9) Why do these belts of wind shift north and south each year? (10) Explain how it happens that when air rises, rain commonly follows. (11) Also, why, when it settles, dry weather results. (12) Tell about the rainfall in the belt of calms. (13) In the trade-wind belts. (14) In the horse latitudes. (15) In the belt of prevailing westerlies. (16) Why do some places have both a rainy and a dry season each year? (17) Explain monsoons. (18) Where are they best developed? (19) What is their influence on rainfall? (20) Why are the winds in the northern hemisphere less regular than those in the southern? (21) Tell about cyclonic storms in the United States. (22) In Eurasia.

Suggestions. — (1) Make a drawing to show the direction of the regular winds of the world. (2) Watch the higher clouds to see in what direction they are moving. (3) Explain what is meant by a rainfall of sixty inches. (4) Measure the amount of rain that falls in a wash-tub during a single storm. (5) Write a clear statement of the reason why there are desert belts both north and south of the equator. Give examples. (6) Examine and explain some maps issued by the Weather Bureau. (7) Observe and record the changes in wind direction, temperature, and rainfall during the passage of a cyclonic storm. (8) Read the chapter on cyclonic storms in Tarr's First Book of Physical Geography, pp. 102–125.

V. DISTRIBUTION OF TEMPERATURE AND A STUDY OF OCEAN CURRENTS

Distribution of Temperature

Although you have studied about *belts* of wind and rain, you have noted that there are many irregularities and exceptions. This is due to the fact that the boundaries of the heat belts are also irregular, as is shown by the isotherms [1] on the isothermal charts of the world.

If nothing else influenced temperature excepting distance from the equator, the isothermal lines would be parallel to the circles of latitude. In our study of North America, however, we have already learned that the temperature of a country is determined by several factors besides latitude. These are (1) *altitude;* (2) the *nearness to a large body of water;* (3) the *direction of the prevailing winds;* and (4) *ocean currents.* Let us see how each of these causes interferes with the regularity of the isotherms.

Effect of Highlands. — Mountains are colder in both summer and winter than low lands in the same latitude. Therefore, in crossing mountain chains the isotherms bend toward the equator. Our small maps do not show this.

Effect of Distance from Sea. — Comparing Figures 36 and

[1] An isotherm is a line connecting places having the same average temperature.

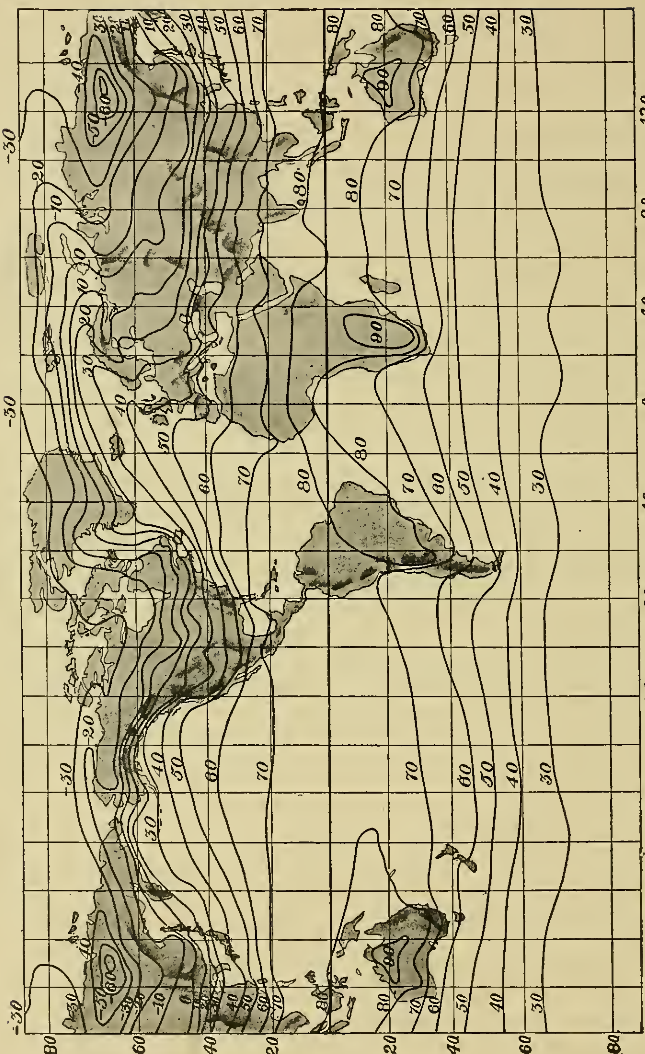


FIG. 36.
An isothermal chart of the world for January.

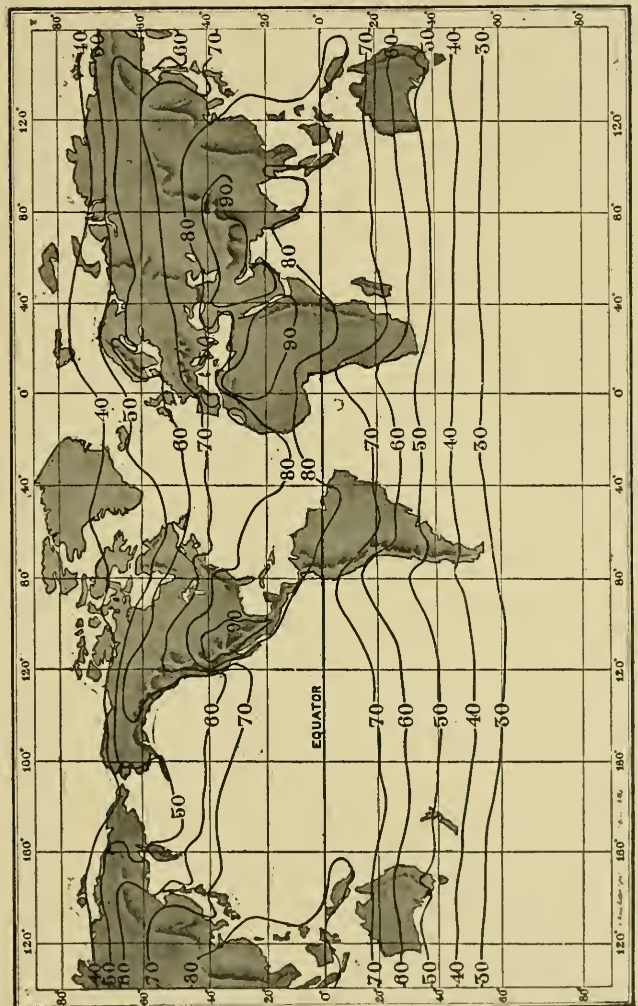


Fig. 37.

An isothermal chart of the world for July.

37 you will notice that the winter isotherms of the north temperate zone bend *toward* the equator over the continents because the land then becomes very cold. During the summer, on the contrary, the isotherms curve poleward, showing that the interiors are then warmer than the coast lands in the same latitude. This gives great temperature changes from winter to summer, as, for example, on the plains of the United States and Canada. Where else on the charts do you find similar extremes of temperature? In what continent is there a still greater seasonal change in temperature than in North America? Why?

Effect of Prevailing Winds. — Along the coast of western North America, from California to Alaska, the isotherms do not follow the parallels of latitude, as we might expect, but extend northward and southward almost parallel with the coast. The reason for this peculiarity is that the prevailing winds are the westerlies, which, blowing from the Pacific, bring to the land the nearly uniform temperature of the ocean. Can you find other windward coasts where a similar influence is exerted?

You will notice that there is only about 20° difference between winter and summer temperatures on the western coast of North America. But on the eastern coast of the United States the difference between summer and winter is much more marked, because, while some of the winds are from the ocean, still more are from the land, which is cold in winter and warm in summer. Compare the eastern and western coasts of Eurasia in this respect. Why does the southeastern coast of South America have less change from summer to winter than northeastern North America?

Ocean Currents

Cause of Ocean Currents. — There are also many variations in the course of the isotherms over the oceans. To explain these it is necessary to understand the ocean currents, which, you will remember, are caused by the winds. By blowing steadily over the surface of the water the winds not only set it dancing in waves, but also cause it to drift before them. This fact is illustrated by the currents along the northern shores of the Indian Ocean. In winter the waters flow southwestward, driven by the northeast monsoon; but during the summer monsoon, when the wind changes to the southwest, the currents are reversed, and there is a drift toward the northeast.

Knowing the direction of the regular winds, we can understand the course of the ocean currents. Were there no continents, the waters of the ocean would drift round the earth in two sets of opposite currents, eastward in temperate latitudes, where the prevailing westerlies blow, and westward in the trade-wind belts.

In the broad expanse of ocean to the south of Africa and South America, where there are no lands to check the water, there *is* a steady eastward drift of the water (Fig. 38). But where the oceans are partly enclosed between the continents, the great currents are so turned by the land as to form five vast eddies of slowly drifting surface waters, two north of the equator and three south of it. These bring enormous quantities of cool water into the torrid zone, so tempering the heat as to make that region habitable. And they also bear back toward polar latitudes stores of heat sufficient to adapt, to man's commerce and tillage, shores and lands that would otherwise be icebound.

The Pacific Currents. — In the Pacific Ocean the equatorial drift, caused by the northeast and southeast trades, moves toward the continents and islands of the Old World (Fig. 38). Upon approaching these lands the drifts are turned, a part to the south, a part to the north. Under the influence of the earth's rotation the southern current is turned to the left, the northern to the right. Thus the northern current swings past the East Indies and Japan, and, still turning under the influence of rotation, leaves the Asiatic coast and returns toward America, now driven by the westerly winds as a broad drift. Approaching British Columbia, most of the water continues to circle to the right, passing southward and, as it turns eastward again in the trade-wind belt, finally completing the great eddy of the North Pacific.

Where this drift crosses from Japan it is known as the Japan Current (Fig. 38). In its waters tree trunks and other tropical products are borne far away to the treeless islets northeast of Japan. The northward bend of the isotherms over the ocean (Fig. 36) suggests the enormous stores of heat which this current carries from the torrid zone. The westerly winds bear some of this warmth to the western slopes of Canada and the United States.

A small branch of the current turns northward along the Alaskan coast, and its warm waters temper the winds of Alaska. There is also a current between the Japan Current and the coast of Asia. But this is a drift of cold water from the north, as you can see by noticing how it bends the isotherms southward near the coast (Fig. 37). Winds from this cold current chill the Siberian coast, and cause the harbors, like that of Vladivostok, to be icebound in winter. This explains why Russia has leased the Chinese harbor at Port Arthur south of

FIG. 38.

A chart showing the principal ocean currents and ocean drifts of the world. Study this map carefully. Make a sketch map somewhat like it. Compare the direction of the currents with that of the winds in Figure 25.

Korea, as a terminus of the great Siberian railway, — that her commerce and war-ships might not be shut up in winter.

Eddies of the Southern Oceans. — In the South Pacific, South Atlantic, and Indian oceans, the same causes have produced eddies similar to that of the North Pacific; but here the earth's rotation deflects both winds and water currents to the left. Some of the water of these eddies joins the broad West Wind Drift of the distant southern ocean; but much of it turns northward until it once more reaches the trade-wind belt, thus completing the eddies.

The north-moving portion of these eddies brings cool water toward the equator and thus chills the ocean, and, therefore, the winds that blow upon the neighboring lands. On Figure 36 find some places where the isotherms bend northward, showing this effect of these currents. Where do they bend southward, showing that warm water is being carried from the torrid zone? Compare the isothermal and ocean current charts (Figs. 36, 37, and 38) to see which currents are responsible for this bending of the isotherms.

North Atlantic Currents. — In the North Atlantic the isotherms are even more irregular, and we readily see that the effect of the currents on the lands and peoples is more important. To value rightly these effects on life we should know their causes. Since the eastern angle of South America is south of the equator, it turns more of the equatorial drift of water into the North Atlantic than into the South Atlantic, as Figure 38 shows. The greater part of this northward-moving drift circles to the right, outside the West Indies (Fig. 39), and crosses the ocean toward Spain. A large portion of it then returns to the trade-wind belt, completing the eddy.

A small part of the equatorial drift passes into the Caribbean Sea and the Gulf of Mexico, and there is heated still further. Escaping between Florida and Cuba, this current is increased in velocity as it is forced through

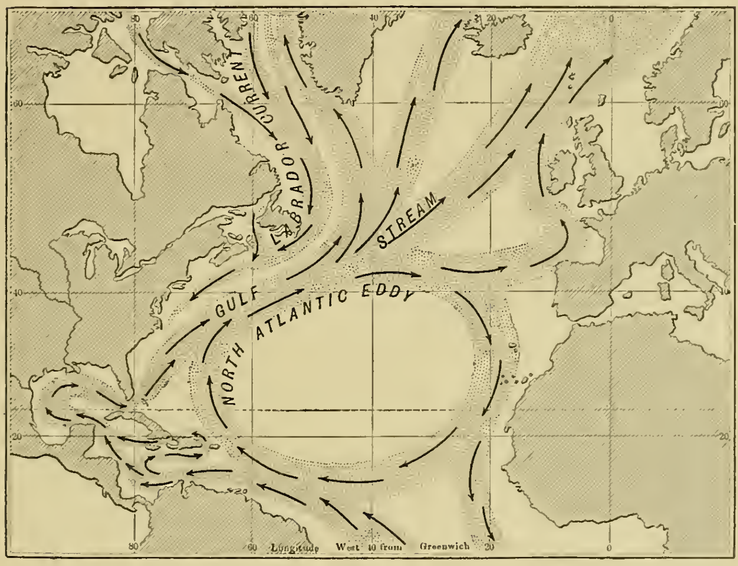


Fig. 39.

A diagram to show the currents of the North Atlantic. In order to illustrate the currents clearly it has seemed necessary to make them as if they were sharply bounded, like a river in its channel. As a matter of fact, however, the boundaries of these great currents and drifts are so indefinite that, in crossing them, one would not be able to detect the boundaries even by using the greatest care.

that narrow strait. Its speed increases to four or five miles per hour, and it therefore well deserves the name of Gulf *Stream*.

Turning toward the right, the Gulf Stream reaches the belt of prevailing westerly winds, where its waters are driven onward to the northern coast of Europe. This drift is joined by water, driven by the west winds, from the great North Atlantic Eddy, and thus vast quantities of warm water are moved into the northeastern Atlantic and even into the Arctic to the north of Europe.

Westerly winds, warmed in passing over this drift, have made possible the great civilized nations of northern Europe, the fatherland of so many Americans. What a striking contrast these nations present to the scattered savages of dreary Labrador and Kamchatka, in the same latitude, whose winds come either from the land or from over cold currents. Notice how far northward the isotherms of the northeastern Atlantic curve in January (Fig. 36), when the strong westerly winds of that season bear warm waters onward into the cold northern ocean. Owing to this warmth Russia is able to have a harbor on the very shores of the Arctic.

Much of the water which enters the Arctic from the south returns in the Labrador Current (Fig. 39), a cold current which flows between the Gulf Stream and the shores of Labrador and New England. It is partly the easterly cyclonic winds from over this cold current that make Labrador so bleak, and the New England coast so agreeable in summer and so damp and chilly in winter.

The isotherms of the North Atlantic are close together as they leave America, but spread apart like a fan toward the Old World (Figs. 36 and 37). The cause is evident. On the American side the currents approach each other, one from the north bearing Arctic cold, the other from the warm south. This causes great temperature contrasts between our northern and southern coasts. On the European side one part of the ocean drift passes northward, raising the temperature and bending the isotherms far northward. The remainder turns southward and, being somewhat cooler than the region into which it enters, slightly lowers the temperature and bends the isotherms southward. Thus the isotherms are spread apart.

When the first settlers came from England they expected to find in the New World a climate like their own in the same latitude. They were unprepared for the severe winters which they actually found, and thus the first settlements on the New England and Canadian coasts were failures.

Review Questions — (1) What factors determine the temperature of a country? (2) What is an isotherm? (3) How do highlands affect the isotherms? (4) Give examples showing how isotherms are affected by distance from the ocean. (5) By prevailing winds. (6) State the cause of ocean currents. (7) Locate the five vast eddies of ocean waters. (8) Tell about the Japan Current and its effects. (9) Tell about other currents in the North Pacific and their effects. (10) Tell about the eddies in the southern oceans, and their influence on the isotherms. (11) Describe the North Atlantic Eddy and the Gulf Stream. (12) How do they influence the isotherms? (13) In what respects are the Gulf Stream and the West Wind Drift particularly important? (14) Locate the Labrador Current and state its influences. (15) How are ocean currents of great service in both frigid and torrid zones?

Suggestions — (1) Does the presence of a warm or cold current near a certain country necessarily greatly affect the climate of that country? (2) Locate the cold ocean currents of the world. The warm currents. (3) What is the effect of warm currents upon the building of coral islands? (4) Tell about the icebergs in the Labrador Current. (5) Estimate the length of the circumference of the great eddy in the North Pacific. (6) Name several points in the world that have about the same average temperature in January as Chicago. (7) Which of these would have about the same *range* of temperature, — or difference between summer and winter, — that Chicago has? (8) What is meant by the heat equator? Where is it in July? (Figs. 31 and 32.) In January? Where farthest from the geographic equator? Why? (9) Follow one of the isotherms on the map and explain the larger irregularities.

VI. PLANTS AND ANIMALS

Zones of Life. — As there are three zones of climate, — tropical, temperate, and frigid, — so there are three great divisions of life; for both plants and animals vary with temperature and rainfall. State some reasons why this must be true and give illustrations. But since there are differences of climate within each of the great zones, there must also be differences in the plant and animal life. We shall now study about some of the great life zones.

Tropical Forest Belt. — The tropical zone is a region of continual warmth and, in many portions, of abundant rainfall. Name some of the sections in this belt that have heavy rainfall. In this hot climate the vegetation retains its leaves and grows throughout the year. Owing to this fact and to the abundant moisture, the foliage is very heavy (Fig. 40) and the ground is densely shaded. Among the trees there are many of great value either for their wood, their sap, or their fruits. Mention some of them. Name some valuable food plants that grow only in tropical regions.

The dense foliage of the forests greatly hinders evaporation, and renders the atmosphere so damp that many plants thrive with their roots in the air instead of in the soil. Aside from trees, therefore, there are vines and hanging plants without number (Fig. 86), some of the most beautiful kinds being the orchids which abound. The forest tangle thus produced is almost impenetrable.

The labor required to clear land producing such vegetation — and to keep it clear for farming — is far greater than in the temperate forest regions of the United States. This difficulty is increased, too, by the extreme heat and

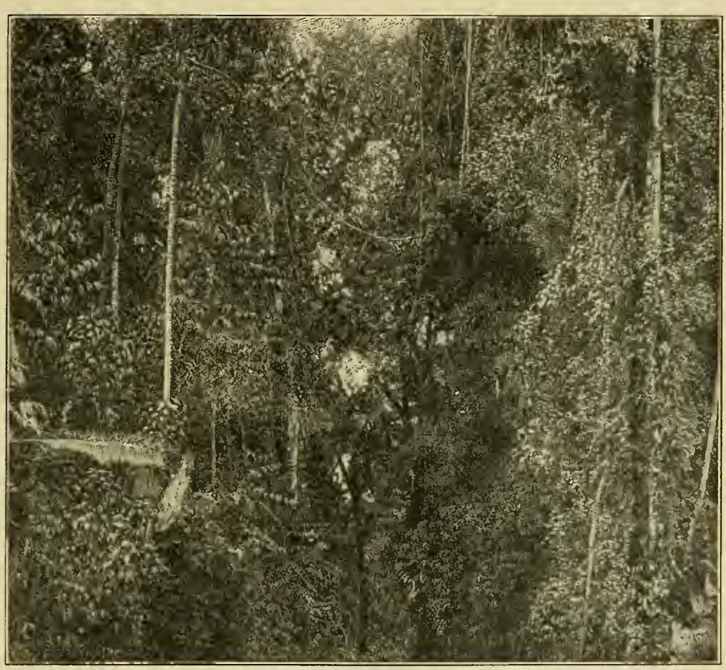


FIG. 40.
A view in the tropical forest of South America, showing the dense tangle of vegetation.

by the unhealthfulness resulting from dampness. For these reasons, in spite of the great fertility of the soil, the zone of dense tropical forests is almost everywhere sparsely inhabited; and in nearly every case its inhabitants are savages. They have become accustomed to the climate, and, owing to the ever present supply of food which the surrounding trees and bushes afford, they find little work necessary. Is that good fortune for them? On the other hand, there is an enormous variety of animals in this forest belt. Can you give reasons why?

Among the animals insects are especially abundant. Some, like the beautiful butterflies, thrive because of the abundance and variety of tropical flowers; others, like many species of ants, live in the decaying wood; and still others have their homes in the ground. Some are harmless; but many, like the ants, which swarm in great numbers, are very troublesome.

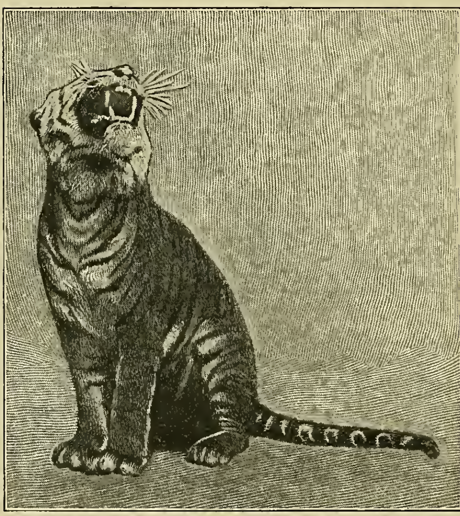


FIG. 41.
The tiger of India.

Where there is much fruit and insect life for food, birds abound; and the variety and beauty of the humming-birds, parrots, paroquets, birds of paradise, and other species of bird life in the tropical forest, are far famed.

Among the mammals there is less variety and abundance, the greatest number, as the monkeys and sloths (Fig. 81), being tree-dwellers. Others, like the tapir, live in the swampy undergrowth; and some very large animals, like the rhinoceros and elephant (Fig. 52), still live in the dense forest, where it is difficult to hunt them. Occasionally, too, fierce animals, such as the tiger (Fig. 41), in the Old World, and the jaguar, in the New, lurk in the densely growing vegetation, ready to pounce upon the more defenceless, plant-eating animals.

Reptiles also thrive in the warmth and dampness of the forest. Great snakes twine themselves like huge vines among the trees and underbrush, and poisonous serpents are common. The standing bodies of water encourage water life, — for example, the turtle and alligator among reptiles, and the hippopotamus and manatee among mammals.

It is, first of all, the dampness and warmth that lead to so much animal life. But another fact should also be kept in mind; namely, that there is a great abundance of plants upon which the animals can feed. Even those, like the jaguar, that live upon other animals, are finally dependent upon plants; for the animals upon which they feed are, in most cases, plant eaters.

Savannas. — On either side of the tropical forest is a belt where the temperature is always high, but where the rainfall varies with the season, being rainy when the belt of calms migrates to it, and dry in the opposite season when swept by the trade winds (p. 34). This belt of alternate dry and moist conditions is best developed in the interior of continents, and is rarely found on east-facing coasts. Why not?

Owing to the absence of rain during one season, dense forests are impossible; but some plants, such as grasses, thrive. These are therefore grass-covered lands and are known as *savannas* (Fig. 42).

The *downs* of northern Australia, the *park lands* lying both north and south of the equator in Africa, the *campos* of Brazil, and the *llanos* of Venezuela and Colombia, are all examples of savannas. They are dry and barren in one season, fresh and green in the other. Trees, such as palms, line the streams; but elsewhere the land is open. Grass-eating animals roam about; for example, in Africa the antelope, gazelle, zebra, giraffe, buffalo, elephant, and rhinoceros. In addition there are some flesh-eating animals, such as the lion (Fig. 43).

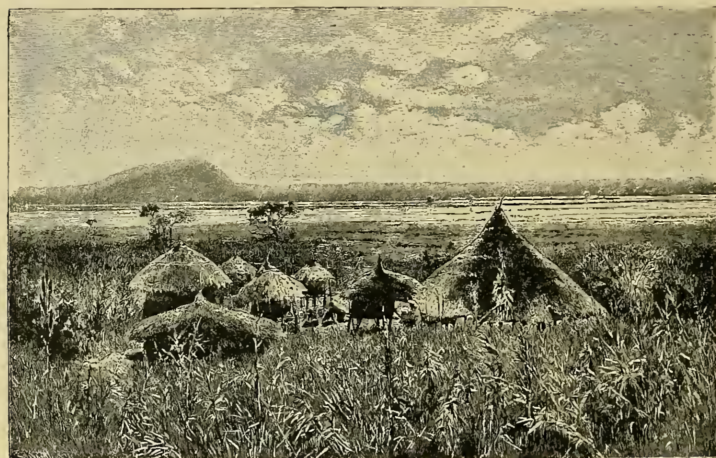


Fig. 42.
Negro huts on the savanna along the Upper Nile.

While tropical forests are unsuited to the life of any persons but indolent savages, the open savannas invite human inhabitants in spite of the heat. They also *compel* industry, because provision must be made for the period of drought. Therefore those African negroes who inhabit the grass lands keep flocks and carry on rude forms of agriculture. Where settled by white men, these savannas are to-day mainly grazing lands; but they are no doubt destined to become the seat of important agriculture, for they are adapted to the cultivation of many subtropical plants.

The Desert. — While the savannas grade into tropical forests on the side next to the equator, they are gradually replaced by deserts on the other side. Locate these deserts in Australia south of the equator, in Asia north of the

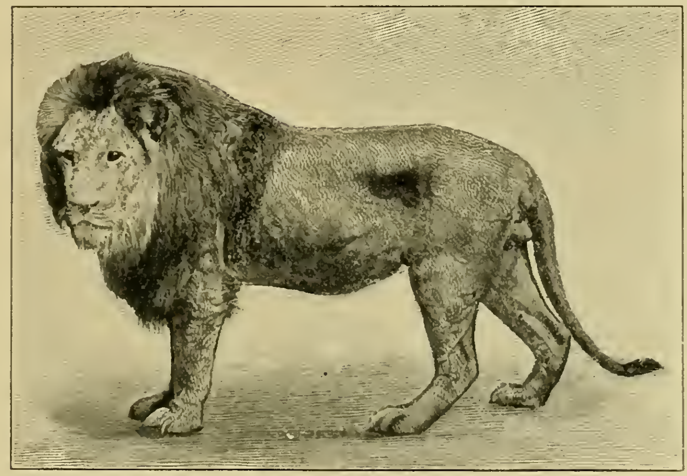


FIG. 43.
The African lion.

equator, and in Africa and America on both sides of the equator (Figs. 26–30). Explain their aridity.

In the desert there are vast stretches in which the sand is moved before the wind and piled into sand hills or *dunes*. There are also tracts glistening with salt where the water of interior basins has evaporated and left salt upon the surface. Parts of the desert are broad plains; but there are also stony plateaus, deep valleys, and mountain ranges.

Throughout much of the desert there is such a lack of rain that the surface is barren and desolate at all times.

But even there, plants and animals are not entirely lacking. In some sections there are scattered clumps of coarse grass; and there are prickly plants, like the cacti and the acacias, in which the leaves and stems are as small as possible to prevent evaporation. In place of a dense tropical foliage there is a marked absence of leaves, and a large part of the plant is underground. This is because the roots must struggle hard to find the necessary moisture, and the portion above ground must use as little moisture as possible and waste none; for years may pass before rain comes.

FIG. 44.
The "Ship of the Desert." Why so named?

That the soil is usually fertile is proved by the fact that wherever there is fresh water, as along a stream, vegetation thrives. Such watered spots in the desert are called *oases*. The Sahara caravans halt in these garden patches, where tall date palms grow and supply a fruit of great value as a food.

One of the few animals native to the deserts of the Old World is the ostrich. Another, much used by man, is the camel (Fig. 44). The latter well illustrates how animals become adapted to their surroundings. Each foot has a broad sole which aids it in travelling by preventing the feet from sinking into the sand. The nostrils can be closed when necessary and the eyes are protected by a veil of hair. Both of these devices are of much use in keeping out the sand which is so often blown about. The camel is further provided with pouches in which enough water may be stored to serve it two or three days; and owing to its fatty hump, which can be drawn upon for the nourishment of its body, it can also go without food longer than most other animals.

Human beings naturally shun the desert. Permanent homes can exist only on the oases (Fig. 45); but wandering tribes, or *nomads*, roam about there. They live in temporary tents, and are engaged in herding, or in driving caravans of camels laden with articles of trade. Sometimes they even raid the caravans of others for the booty they may obtain.

FIG. 45.
Loading a camel on an oasis in Algeria.

Life in Temperate Zones. — The land of temperate zones is typically forest covered. This is not due to abundance of rainfall so much as to moderate evaporation in the cool climate, which permits the ground to remain moist throughout the summer. Thus a broad forest belt crosses the northern interiors of both North America and Europe. Owing to the less extensive rainfall in some parts, and to the rigor of the climate in others, the forest is more open than in the tropics.

Steppes and Arid Plains. — There are also treeless, grass-covered lands in the temperate belt, usually on the border of the deserts in the interior of continents where the rainfall is light. In the Old World, where these tracts are called *steppes*, there is a broad strip extending from southeastern Europe to central Asia. The *Great Plains* of

FIG. 46.
A group of Persian nomads with their summer tents.

western North America, and the treeless plains, or *pampas*, of Argentina are also steppes (Fig. 91).

Spring rains cause the grass to be green in spring and early summer; but drought then changes it to gray and yellow. There are no trees excepting along the streams; and only on the very border of the steppes is there rainfall enough for agriculture without irrigation. The wild animals are grass eaters (*herbivora*), and the steppes formerly supported great herds of deer, antelope, and bison; but cattle, sheep, horses, and camels have largely replaced them. The inhabitants of the steppes in the Old World have for many centuries led a pastoral life and have become nomads. They wander about and live in tents during the summer (Fig. 46); but in winter they select more permanent homes for the sake of protection against the weather. They depend upon the horse to such an extent that it has become almost a part of their life.

Prairies. — Besides the vast tracts of arid steppes, there are some treeless plains even in parts of the temperate zone where the rainfall is heavy enough for tree growth. Examples of these are the *prairies* in the United States and some of the plains in southern Russia. Some think that fires have removed the forests; others that the fine-grained soil has prevented tree growth; but probably each cause has aided.

Forests of the Temperate Zone. — Near the torrid zone the trees are for the most part tropical in kind. In the cooler temperate latitudes, however, they are principally of two sorts: (1) the *evergreens*, including the pine, spruce, and hemlock, that have needle-like leaves which remain green throughout the winter, and (2) the *deciduous* trees, whose leaves are much larger, but fall when frost comes.

The value of the forests to man is great, for the coldness of the climate in the densely inhabited temperate zone demands that men shall build permanent houses for their protection. To what other uses is the wood put? On the other hand, the forests have interfered with man's development, for the trees must be cut away before agriculture is possible. In Europe, however, a large part of the forest has been removed, and much has also been cleared away in the United States. What about Canada?

The temperate forest was the home of many wild animals, now mostly exterminated, or greatly reduced in number. Name some of those of North America. Owing to the coldness of the northern sections these animals are protected by fur, which men find of such use that the hunting of fur-bearing animals is one of their occupations in the forest.

People of the Temperate Zone. — In the temperate zone of North and South America, Europe, Asia, and Australia, both the cleared forest lands and the humid, grass-covered plains have become the seats of extensive agricultural industries. In fact, the temperate zones are the agricultural zones of the world, and they might almost be called the *zones of grain* (Fig. 47). Make a list of the grains that are cultivated; also of the fruits.

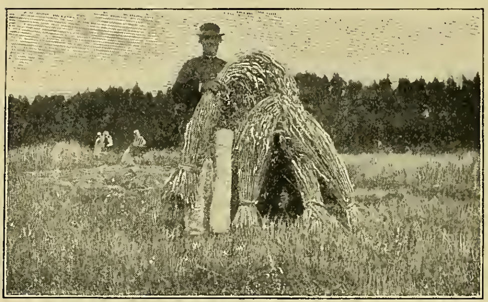


Fig. 47.

A field of grain in Russia with the forest in the background — a familiar scene in the cool temperate belt. Have you seen a view resembling this?

In this temperate belt, too, man has developed most highly. The simple life of the savage in the tropical forest, and of the nomad on the desert and steppes, contrasts strikingly with the varied life of the agricultural people in the temperate belt. Not only are the latter more highly civilized, but they have so increased in numbers that the temperate zone is the most densely populated belt in the world. Suggest some reasons for this.

Life in the Frigid Zone. — As one passes to the colder margin of the north temperate zone the trees become stunted and the conditions grow less favorable to agriculture. Beyond this, stretch vast expanses of frozen ground known as the *tundras*. These are covered with snow in

FIG. 48.
A camp on the edge of the tundra of northern Asia. What do you see in this picture?

winter; but in summer, when the snow melts, they are in most places exposed to the air.

During summer the frost leaves the ground to a depth of two or three feet, although below that depth the earth remains frozen for scores of feet. The continual thawing at this season keeps the soil so moist that the tundras are everywhere swampy, even on the hillsides. Then everything grows rapidly; the green grass springs up and bright flowers dot the turf. No large bushes or trees are to be seen, for all plants remain as close to the ground as possible. Why should they?

These regions are often compared with the tropical deserts in their absence of animal life; and the reindeer is compared to the camel because it permits a few persons to eke out an existence in the frozen desert (Fig. 48). But there are differences; the tundra is a desert because the cold prohibits most forms of life during the greater part of the year, while the tropical desert is *always* forbidding. Why? During the short summer, when the tundra blossoms into life, swarms of insects, especially mosquitoes, infest the morasses; and the berries of the previous season, uncovered from the snows, supply food to land birds. Why should these birds, together with the foxes and polar bears, be protected with *thick white* coats?

While life in most forms is scarce on the tundras, along the seacoast it exists in abundance. Vast numbers of birds feed upon the minute sea animals in summer, and migrate southward in winter when ice covers the sea and cuts off their food supply. The walrus, whale, narwhal, and seal sport in the water, the latter in such numbers as to supply the chief food for the scattered colonies of Eskimos and other people who live along the coast.

Oceanic Life. — There is little variety in the plant life of the sea. Animal life, on the other hand, is extremely varied and abundant. Countless millions of minute creatures, floating in the surface waters, serve as food for larger species, such as the whale and the food fishes. Some of the food fishes, as the mackerel and menhaden, swim at the surface in multitudes, called *schools*. Others, as the halibut and cod, live on the bottom, especially on those shallow banks that are swept by the food-bringing currents.

Animals inhabit all parts of the ocean, even the deep sea and the surface water far from land. But the chief fishing grounds are the seacoast itself and those shallow banks near the coast that can be easily reached. Besides the various species of food fish, there are shellfish, such as clams and oysters; and crustaceans, such as crabs and lobsters. Among the important lower forms unsuited for food are the sponges, and the tiny corals out of whose limy skeletons many islands in the ocean have been built.

Some of the higher ocean animals once lived entirely on land, and have slowly adapted themselves to the ocean. The polar bear, for instance, lives partly on the ice-covered sea; and many birds, as the penguins and ducks, spend part of their time in the water. The seals, related to the bears, still crawl upon the shore at times, though their natural home is now the water; but the whale never leaves the water, though he must still have air to breathe.

Causes for Distribution of Plants and Animals. — In what has been said about the tropical forests, the camel, seal, and whale, there lies the suggestion that the different sections of the earth were not supplied with certain forms of life at the beginning which they were to preserve throughout all ages. On the contrary, it seems that plants and animals, like man himself, have been forced to adapt themselves to the conditions which surrounded them.

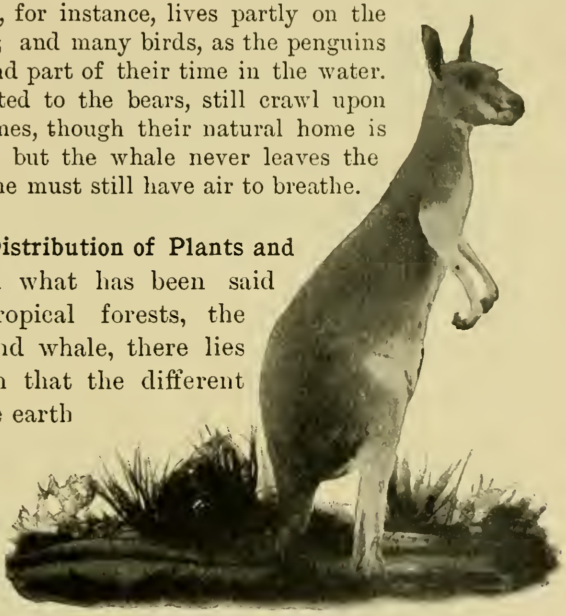


FIG. 49.
The kangaroo of Australia.

This is now generally believed to be the truth. Plants and animals, like the earth itself, have been constantly changing; and the wonderful ways in which they are now adapted to their surroundings is the result of ages of struggle in which tens of thousands of species have been destroyed because they could not fit themselves to the changing conditions. This conclusion finds support from a study of life upon oceanic islands.

Many islands far from land support *some* of the plants and animals that exist upon the nearest continents. For instance, the Bermudas have forms of life similar to those of North America. But many of the species living on the mainland, particularly those kinds that could not endure a long journey, are absent from such islands.

Birds, bats, and insects, being able to fly, naturally find their way to the islands. Some reptiles are also found, since, without food or water, they are able to float long distances clinging to logs. But large and highly developed mammals, like the elephant, tiger, or deer, are almost always absent from oceanic islands.

Australia is really a great oceanic island; but it has many large animals which differ from those found on the other continents. There are kangaroos (Fig. 49), some varieties of which are large, others small like rats, but all of which leap clumsily about on two legs, aided by the large, muscular tail. And there is the duck-billed platypus, which, though a mammal, lays eggs as birds and reptiles do. The peculiarity of these Australian mammals is that their young are not nearly so developed as are the young of the higher mammals. Other Australian mammals, birds, and even plants are also peculiar.

Fossils in the rocks prove that, long ago, animals similar to those of Australia lived on the other continents. It is believed that mammals reached Australia in those ancient times when that continent was still connected with other lands. Then came a sinking of a part of the earth's crust, separating Australia from the other continents, where fierce animals later developed which were unable to cross the sea to Australia. Therefore the weak mammals were able to survive in Australia while the same kind elsewhere were destroyed.

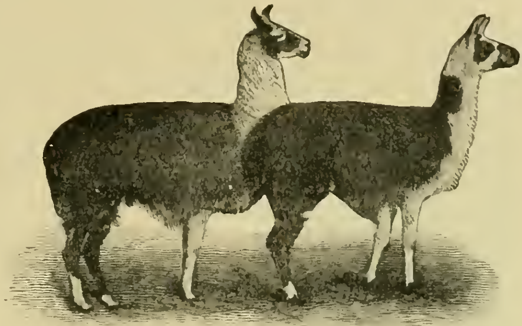


FIG. 50.
The llama of Peru, a South American animal not found in North America.

FIG. 51.
Buffalo cow and camel in the Nile. These animals are common to Africa and southern Asia.

North and South America have some animals in common, such as the puma, jaguar, and tapir; but on the whole there is a marked difference between the faunas of the two continents (Fig. 50). One reason for this difference is that in past ages South America was entirely cut off from the northern continent.

Africa has much the same climate as South America; but, being so widely separated by ocean water, the faunas of these two continents are entirely different. On the other hand, many of the animals of southern Asia, such as the lion and elephant (Fig. 52), are similar to those of Africa (Fig. 51), since the two land areas are so close together.

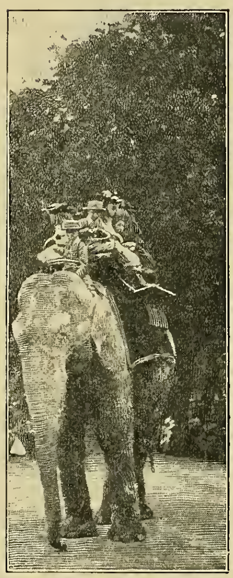


Fig. 52.

The elephant, an animal common to southern Asia and Africa.

The north temperate zone, including much of North America and Eurasia, has closely related species of plant and animal life. Throughout this vast area there are pines, spruces, hemlocks, oaks, maples, etc., on the one hand, and bears, wild cats, wolves, deer, foxes, beavers, etc., on the other. The reindeer of Europe and Asia (Fig. 48) is almost identical with the caribou of America; and there is also a close resemblance among the birds. This similarity is partly due to similarity in climate, and partly, perhaps, to a former connection of the two lands. There is, however, little resemblance between the life of this belt and that of central Africa and southern Asia; for the vast desert belt and the lofty mountains have served as barriers to the spread of plants and animals.

Thus it is seen that the life on each continent has varied from time to time, and that both plants and animals have spread wherever conditions allowed. The greatest barrier to a general distribution has been the ocean; but deserts and mountains have also offered effective resistance. State why.

Changes throughout the ages, causing variations in climate, in the land surface, in the food supply, and in the introduction of new enemies, have brought death to many species. This may be illustrated by those extinct relatives of the elephant, the huge mammoths and mastodons, that formerly lived in the cold temperate zone. It is also illustrated by many birds. In former times running birds (Fig. 53), like the ostrich, were abundant; but they are now giving place to small flying birds, that are better adapted to their environment.

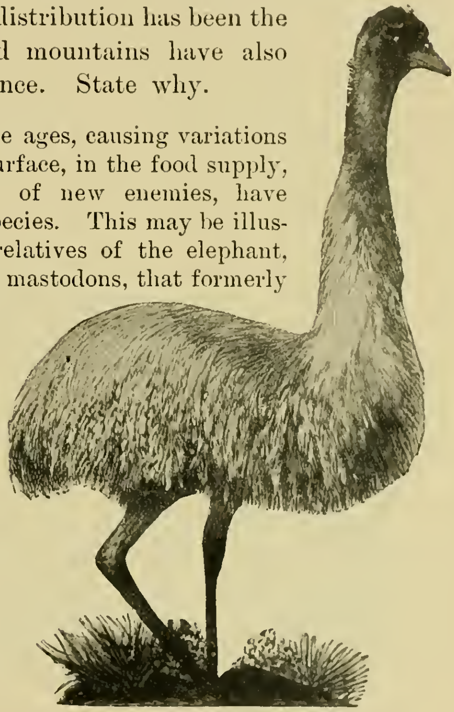


FIG. 53.
The emu of Australia, one of the running birds.

Man is at present one of the most effective agents in producing changes in the plant and animal world. He is constantly developing new varieties of each, while destroying older forms. He has improved and domesticated many wild animals, but has exterminated some, like the auk, and nearly destroyed others, like the bison. The changes he has caused in the vegetable kingdom are to be seen on every hand. Can you mention some of them?

Review Questions. — (1) By what factors are life zones determined? (2) Describe the conditions of plant life in the tropical forest. (3) What effect have these conditions upon human beings? (4) Upon animals? (5) What is the origin of savannas? (6) Locate some of them. (7) What about plants, animals, and people there? (8) Tell about the desert: cause, characteristics, plants, oases, animals, and people. (9) Tell about the conditions of life on the steppes and arid plains. (10) What is known about the cause of prairies? (11) Tell about the temperate forests: trees, animals, and human inhabitants. (12) Tell about life in the frigid zone. (13) Tell about the tundras: vegetation, similarity to the desert, animal life, and human inhabitants. (14) Tell about ocean life: plants, food fishes, other important animals and land animals that have learned to live in the sea. (15) What about the adaptation of animals to their surroundings? (16) What light is thrown upon this question by the life on ocean islands? (17) Give some facts about Australian animals and the reasons for their peculiarity. (18) Tell about the animals on each of the other continents. (19) What are the great barriers to the spread of life? (20) Name some causes for extermination of species.

Suggestions. — (1) Make a collection of different kinds of wood. (2) Notice how some of them are polished for use as furniture. (3) See some orchids, if possible. (4) Visit a museum to see specimens of tropical animals. (5) Examine a cactus closely. (6) Examine and compare the foliage of some evergreens and deciduous trees. (7) Find out what is meant by *evolution* and the *survival of the fittest*, as these terms are applied to plants and animals. (8) What dangerous enemies have you observed for certain plants? (9) For certain animals? (10) Collect pictures of animals belonging to different parts of the world.

VII. THE HUMAN RACE

Divisions of Mankind

Man, like plants and animals, varies in different parts of the world. He is influenced by his surroundings, as they are, and in the course of time has developed differently in the various lands of the earth. Concerning the *origin* of the human race, and its divisions, people hold different views; but mankind in general may be divided into four great groups.

Fig. 54.
An African negro girl.

Ethiopians. — Altogether there are about one and one-half billion human beings upon the earth, or twenty times the number in the United States. Of these the lowest are the negroes (Figs. 54 and 62) or *Ethiopians*, who number about one hundred and seventy-five million. This is often called the *black race*. There are many subdivisions of this group, but they are all characterized by a deep brown or black skin, short, black, woolly hair, broad flat noses, and prominent cheek bones.

The home of the Ethiopians is Africa south of the Sahara desert (Fig. 60), though many have been transported to other lands as slaves, and have there mingled more or less with the other races. In their original home the negroes are savages, or barbarians of low type.

The native Australians (Fig. 55), the Papuans of New Guinea, the Negritos of the Philippines, and the blacks on some other islands in that part of the world resemble the negroes most closely, though differing from them in some important respects. They are shorter, for example, their hair is less woolly, their noses straighter, and their lips less thick.

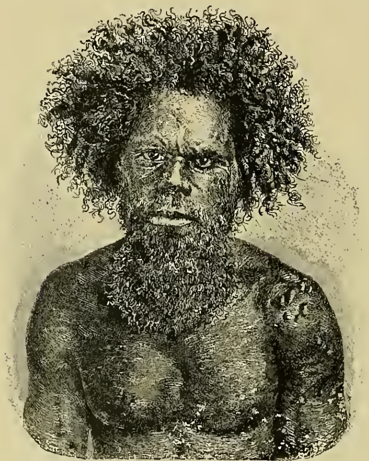


Fig. 55.
A native of New South Wales, Australia.

American Indians. — A second great division of the human race is that of the *red men* or *American Indians*, often called the *red race*. It is the smallest of the four groups, numbering about twenty-two million. These people, who in some respects resemble the Mongolians (p. 73), were in possession of both North and South America when Columbus discovered America. They were, however, divided into many tribes. While the Indians have been largely displaced by white men, many, especially in the tropics (Figs. 56, 61, and pp. 107–109), are still living in the savage state.

They are distinguished by a copper-colored skin, prominent cheek bones, black eyes, and long, coarse black hair. When discovered many were savages, while others had risen to the stage of barbarism. In fact, the Aztecs of North America and the Incas of South America had even developed some of the arts of civilization (p. 109).

Fig. 56.
South American Indians.

Mongolians. — The third division, the *Mongolian* or *yellow race*, numbering about five hundred and forty million, are typically Asiatic people, the greater number being found in Asia and the islands of the Pacific (Fig. 60). Some, as the Finns, Lapps, and Turks, have settled in Europe, while the Eskimos have spread eastward along the shores of Arctic America.

The Mongolians, typically represented by the Chinese and Japanese (Figs. 57 and 68), have a yellowish and in some cases even a white skin, prominent cheek bones, small oblique eyes, a small nose, and long, coarse black hair. In places, as on the more remote islands, the Mongolians are uncivilized ; but the great majority may be classed as civilized people, although their standard of civilization differs from that of the white race.

Caucasians. — By far the largest and most civilized of the four divisions of mankind is the *white* or *Caucasian*

Fig. 57.
Japanese ladies.

race, which numbers about seven hundred and seventy million. Their original home is not known. Some believe it to have been in the plateau of central Asia, others in the northern part of Africa. With the dawn of history the white peoples of Europe were mostly barbarians;

but civilization had begun to develop in southern and western Asia and along the shores of the Mediterranean Sea.

At present the white race occupies most of Europe, North and South America, Australia, and large portions of Asia and Africa. It is the most widely distributed of the four divisions (Fig. 60). Besides Europeans (Fig. 58) it includes the Egyptians, Arabs, and Abyssinians of Africa; also the Arabs, Persians, Armenians, Afghans, and Hindus of Asia (Fig. 59).

FIG. 58.
A Belgian peasant girl.

While for various reasons the Caucasians differ greatly in characteristics, two main branches are recognized: (1) the fair type (Fig. 58), with florid complexion, light brown, flaxen, or red hair, blue or gray eyes, and height above the average; (2) the dark type (Fig. 59), with fair skin, dark brown and black hair, often wavy or curly, and black eyes. In temperament both are active, enterprising, and imaginative, though the fair type is more solid, the dark type more emotional.

Distribution of Races. — For centuries these four great divisions of the human race have been changing within themselves until there are now many subdivisions of each group. By war and invasion they have encroached upon one another, and have intermixed to some extent. But the leaders are the whites, who, having learned the use of ships in exploring distant lands, have spread with

FIG. 59.
A group of Indian Brahmins, who belong to the dark type of Caucasians.

a rapidity never seen before. Also, being more advanced than the others, the white races have readily conquered the weaker people and taken their lands from them. They now dominate the world (see Fig. 60), the only division that has held out against them being the Mongolians, whose very numbers have in large measure served to protect them.

Fig. 60.

Make a sketch map similar to this to show the general distribution of the four races of man.

Development of Civilization

The facts of history indicate that the civilized races of the world have developed from a state of savagery or barbarism. It is further believed that certain races have not developed because of unfavorable surroundings. These are called *natural races* because they still depend directly upon nature for their food, clothing, and shelter, while the more civilized races have to a certain extent risen above such dependence. Therefore, by studying the natural races we may gain some hints concerning the development of civilization.

Fig. 61.
An Indian hunter in the Amazon forest.

Need of Food. — The most essential need of man is food; and human beings in general are so constituted that they will obtain their food in the easiest possible manner. If it grows upon trees near by, or can be obtained by simple hunting devices (Figs. 56 and 61), man is apt to do no more work than is necessary to secure food that is near at hand. His life is simple, his needs are few, and his advance is slight. It is in the tropics that these conditions exist, and it is there that we find the least civilization.

Where these conditions are found only a small number can live, because there is a limit to the food that is easily available; therefore the tropical forest zone is for the most part sparsely inhabited. In fact, it is said that parts of the tropical forest average but one person for every twenty-four square miles; and most of the inhabitants dwell near the rivers. Can you suggest reasons for living there? When the numbers increase greatly, new means of obtaining food must be found; and for this purpose war and even cannibalism are sometimes resorted to.

FIG. 62.
An African negro woman planting.

Development of Agriculture. — But by far the most common means of adding to the supply of food is through the care of plants and animals. The plant world offers valuable foods stored in seeds, bulbs, and roots. Under natural conditions these foods are scattered, and agriculture doubtless began by gathering them from the wild plants, as many native tribes still do. A step in advance would be made by *planting* such seeds near the home and keeping out the weeds (Fig. 62).

Moreover, in some climates it is *necessary to store* a supply against a season of need. For example, the winter of the temperate zones and the dry season of the savannas must be provided for. This encourages industry, thrift, the building of permanent homes, and inventions for saving labor. Thus agriculture is one of the great civilizers.

Agriculture probably began upon the open lands; and among natural races it is for the most part still confined there. Later small patches were cleared in the forest; but this was difficult, especially in tropical countries, where the fight against weeds is a hard one. It is so hard, in fact, that there is little development of agriculture in such woodlands. The temperate forest also offers difficulties, but fewer than that of the tropics, and consequently much of it has been cleared. The frigid zone and the true desert permit no agriculture; but where irrigation is possible the latter may be made to yield a harvest. Mankind early learned to cultivate the soil by aid of irrigation, and some of the seats of early civilization, as in Egypt and Persia, were on river flood-plains, where agriculture was carried on in that way.

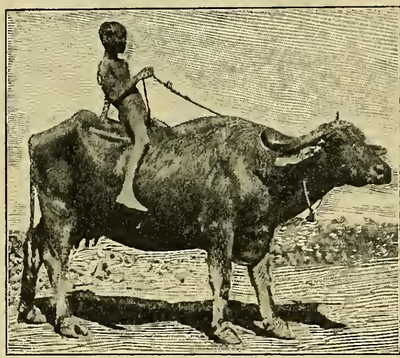


FIG. 63.

The buffalo in Egypt, one of the many native animals that have been domesticated by natural races.

Development of Grazing. — In spite of the fact that it has been difficult to domesticate animals, mankind has made many of them serve his needs. For example, the dog has been made to aid in hunting; the ox, horse, camel and buffalo (Fig. 63) to serve as beasts of burden; the sheep, cow, goat, and others to supply materials for clothing and food. Name some of the kinds of food and clothing obtained from these animals.

While it was doubtless the needs of the farmer that led to the domestication of many animals, it is the herders who have come to take care of them most extensively. The people who make grazing their occupation find it necessary to roam about with their herds in search of grass, and are therefore called *nomads* or wanderers. They naturally show preference for the open plains. Why?

The life of the nomad tends to make him restless, self-reliant, and warlike, while that of the farmer is peaceful. Each

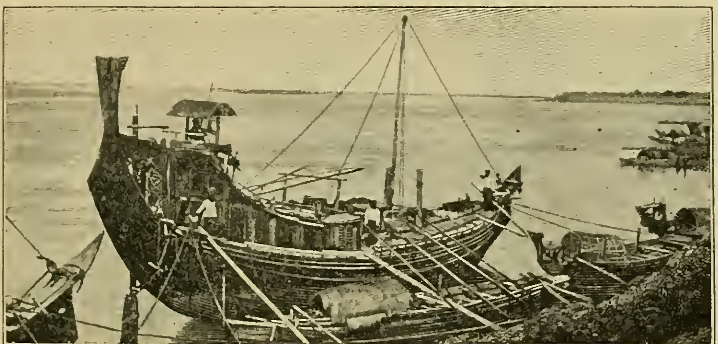


Fig. 64.
One of the boats in use in Burma in southern Asia.

class is capable of development to a certain extent, although in different ways; but the best character comes from a union of the two natures. Fortunately this union has often been effected, though at cost of many human lives. Agricultural people have been much exposed to the raids of nomads, who had little to lose and much to gain by such war. In consequence most agricultural races have become mixed with nomadic people; for the latter have often conquered whole sections of agricultural country. For example, the Chinese are an agricultural race who have been influenced in this manner; and nomadic hordes from Asia made many incursions into Europe in early days.

Development of Fishing. — A third direction in which natural races have made progress is by contact with the sea. To obtain food from the sea, boats were needed (Fig. 64); and when men had come to use them with skill, they were able to explore regions beyond their horizon. The use of the boat produces men of energy, courage, and skill. Partly as a result of this, and partly because of the protection which the sea furnishes against invasion, the highest advance of races has occurred along the seacoast, especially on islands and peninsulas. Why there? It may be said, in fact, that civilization has in general spread from the coast to the interior.

Development in the Temperate Zone. — It is along the coasts of the temperate zones that the greatest progress has occurred, because, while there are difficulties to overcome, they are not great enough to discourage. The need of storing supplies for winter has led, by natural steps, to the accumulation of wealth, to trade, and to various other forms of industry. The farmer, herder, and fisherman supply food; but they in turn need implements, clothing, and other articles. At first, among natural races, each man supplies these for himself; but with further development it is found desirable to devote one's whole time to one's special occupation. Thus some obtain food, others make weapons, tools, etc.; and by the exchange which thus arises, commerce is developed, and with it a great advance is made.

Shelter. — Even the most primitive races have need of shelter from the heat, cold, or rain. To this day some live in hollow trees, like the beasts; but most have developed a higher type of shelter. A more advanced stage is reached when the limbs of low trees and bushes are bent over and woven together for protection; or when bushes are stuck into the ground and their limbs fastened together. Beginning with these simple devices, there is every gradation to the elaborate grass huts of the negroes (Fig. 65) and the wooden houses of the whites.

Fig. 65.
Huts in a negro village in Africa.

Early races often lived in caves, especially where the climate was so cold that winter protection was necessary. This was true of early Europeans and of some American Indians; it is still practised in parts of the earth. It is a step in advance to build partial houses beneath overhanging cliffs, where the roof and one wall are supplied by the solid rock, as among the cliff dwellers of western United States. Then comes the house composed entirely of stone, or of dried clay, either the sun-dried adobe or the baked brick. The highest development of architecture is reached in the massive public buildings of the present day.

Nomadic races, travelling about as they do, require portable dwellings (Fig. 46); and their most common shelter is composed of skins, which are not only light but easily obtained from their herds. In case of longer residence in one place they may build more permanent homes, either of wood, clay, or stone. Also, with abundance of wool and other kinds of animal hair, these people have learned to weave blankets and rugs, which are an additional shelter when travelling.

From these facts it is seen that natural and semi-civilized races obtain shelter by the use of materials near at hand and adapted to their mode of life. This is especially well illustrated by the Eskimos, whose summer homes, when they are moving about, are made of seal and walrus skins; while their winter shelter is built of blocks of ice or snow, the most available building materials.

Sites for Houses.—The sites for these dwellings often seem to be selected with reference only to the nearness of building materials or of food. But very commonly they are determined by the necessity for protection from man or beast. The cliff dwellers of the West, for example, selected their sites with the idea of defence against wandering tribes of savage Indians; and the Pueblo Indians built their pueblos upon hills for the same reason. Civilized people, likewise, have often located their castles upon lofty cliffs. Find illustrations in the sections on Europe. Among natural races, houses are sometimes built in the treetops

Fig. 66.
Houses in the trees in New Guinea.

(Fig. 66) for protection against enemies; and sometimes they are even built on posts or piles in the water (Fig. 67).

Towns and Cities. — The same reason that induces natural races to build their houses in positions which afford protection from enemies, has caused people to collect in villages (Fig. 65), towns, and cities. These are often

Fig. 67.
A village on piles in New Guinea.

surrounded by water (Fig. 67) or by stockades; and in the Middle Ages the cities of Europe were very effectively protected by walls of stone. Many European and Asiatic cities are still enclosed in walls, and in Asia they are even now kept in repair; but the modern cannon render such defences of little value.

While the sites of some cities have been selected for no other reason than their ease of defence, the growth of civilization has given other reasons for people to collect in cities. For example, some have simply wanted to live together, or to be near valuable mineral deposits, or near water power, etc. Give other reasons.

Clothing. — In regard to clothing, as to shelter, there are many varied customs. Here again the natural races show most dependence upon their surroundings. Some of those in the tropical zone find very little clothing necessary (Figs. 56, 61, and 87). Others clothe themselves in bark, as some of the Germanic people of Europe did in early times. In the cold climates skins are used, as among many of our European ancestors, and at the present time among the Eskimos, Lapps, Fuegians, and some of the North American Indians. What other reason than cold would lead these people to use fur-bearing skins?

Fig. 68.
Japanese rain coats.

From the use of such simple natural products it is but a step to crude hand manufacture; then follows manufacture by machinery, run first by hand or foot (Fig. 58), then by water power, and finally by steam and electric power. Doubtless at first such native products as the wool of animals, the fibre of wood, wild cotton, and flax were used; then plants and animals were raised for their fibre and hair. Even the insects are called upon to aid man in his attempt to clothe himself; for silk is used in many lands.

The Development of Language. — There are hundreds of different languages among the races of the earth, and no one knows their origin and history. In the very earliest times about which we know there were vast differences of speech; and even since history began to be recorded, the speech of nations has greatly changed. For example, the Greek and Italian languages of to-day are very different from the Greek and Latin of two thousand years ago.

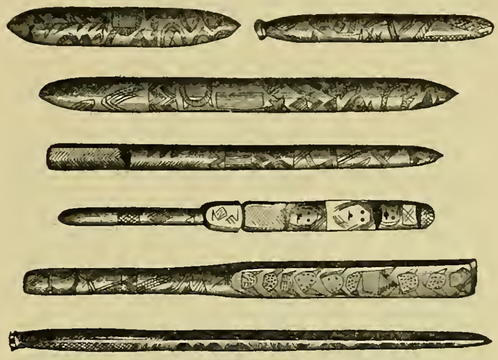


FIG. 69.

Message sticks from West Australia — the carvings convey messages.

This being the case, it is easy to see how, if time enough is granted, races separated by the sea, mountains, or desert will slowly give up old words and evolve new ones. This is thought to be the origin of the many different languages of the globe. How are these differences in language important in checking commerce and preventing sympathy of one nation for another?

Many natural races have no written language; others have a kind of picture writing (Fig. 69); that is, they represent their ideas by drawing pictures. It is from such a beginning, it is believed, that our writing and, later, our printing have developed. Writing and printing have been among the most powerful aids to civilization. Can you suggest reasons for this?

Inventions. — Even the lowest races are gifted with some ingenuity and power of invention. The savage hunters of the forest make the bow, arrow, and spear (Figs. 56 and 61). Most if not all races know the use of fire and how to make it. Also pottery-making is common to all parts of the earth.

Fig. 70.
A boat with an outrigger to prevent capsizing. — Hawaiian Islands.

Farming has been responsible for many inventions — the implements for loosening the ground (Fig. 62), for planting, for reaping, for employing beasts of burden, including the harness itself, being good examples. Fishing has also given rise to many ingenious devices, especially in the demand for boats. Some boats are of bark, as among the Indians ; or of skin, as among the Eskimos, where bark is absent ; or of hollowed logs, as in many parts of the world. In time the small, open boats (Fig. 70) were replaced by larger, covered vessels (Fig. 71); and finally huge ships have been made of steel. As to motive power, oars and paddles (Fig. 67) were first used, then the wind was called into service (Fig. 71), and finally steam. Ships are one of man's most important inventions. Why? Of what service have printing, gunpowder, steam, electricity, and labor-saving machinery been in advancing civilization?

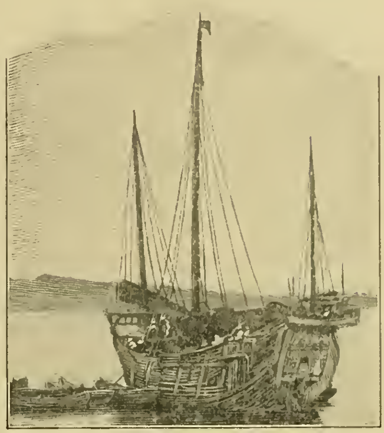


Fig. 71.
A Chinese junk, a form of sailing boat long in use by the Chinese.

Civilized man, instead of depending upon wild plants and animals for food and clothing, has learned to cultivate the choicest of plants. He has tamed and domesticated many species of animals, too, and used them not merely as a source of food but also as an aid in his work. More than this, he has learned to control some of the forces of nature and has caused them to do his work in an improved fashion. The result of it all is that thousands of people are able to live where only one could exist in the natural state. For example, while in some parts of the tropics there is an average of but one savage for every twenty-four square miles, there are whole countries that average several thousand civilized men on the same area.

Development of the State. — While in some tribes there is scarcely any real government, the need of a leader so frequently arises, as in the management of a boat or in war, that in most cases there is some organization. Further than that, war is so common among savage and barbarous races that it is of interest for different tribes to combine under a good leader. This forms a beginning of tribal government and of the *State*.

Sometimes, as among the Indians, the *chief* is merely a representative of the people, leading them, but not having absolute power. In other cases he is a despot to whom all subjects must yield obedience. Their property, movements, and very lives are at his mercy, his authority often being made especially secure by means of religious beliefs and rites, as among many African tribes.

In early times Europe was occupied by scattered, warring tribes governed in this loose manner. But with the development of Roman civilization on the Mediterranean, much of western Europe came under the Roman influence, and laws and customs were established which have aided greatly in the later civilization of European nations. With the decline of the Roman Empire, however, these tribes sank back in part to their old conditions. *Kings* ruled portions of the country and fought battles with neighbors, aided by leaders or *lords*, who themselves often became so powerful as to be dangerous rivals to the kings. These lords lived in well-protected castles, surrounded by farms which were worked by the common people, or *peasants*, who were little better than slaves. They were called *vassals*, and were required to serve their lords and to fight for them.

Under such conditions little advance was possible; for while a few persons possessed much power, the masses were kept in poverty and ignorance. Little by little, however, the people have made progress toward freedom; and to-day they are in the main emancipated, although in their kings and lords most countries of Europe still preserve relics of the old system.

Among the causes which have aided in the elevation of the people, perhaps none were of more importance than the discovery and exploration of new lands. Explain how that is true. The masses reached the point where they demanded the right to make their own laws; and in some countries, as in France, they even replaced the monarchy by a *republic*. In England a full measure of liberty was obtained without abolishing the monarchy, but only after many severe struggles. In America, separated from the Old World customs, and peopled by those who fled from oppression, the love of freedom was prominent from the very first; and neither hereditary king nor lord checks the masses from the full enjoyment of their liberty.

Development of Religion. — True religion is the climax of man's development; yet every race has some form of religion. Among savages it is little more than superstition. They are surrounded by nature, which they do not understand. Life and death mystify them; the tree develops from a seed, and the savages know not why; on every hand is mystery. They seek a cause, and, seeing none, are led to believe in spirits which they try to comprehend. Some they suppose to be evil, others good. Believing that these spirits have great influence over their lives, they try to win favor with them by offering sacrifices and worshipping them.

Such religion, if it may be so called, takes many forms. Some races, as the negroes, believe in witchcraft; and among them the witch doctor is sometimes more powerful than the ruler himself. If disease comes, it is ascribed to an evil spirit, and it is believed that the witch doctor can effect a cure. To ward off such evil influences charms are worn, gross rites are observed, and images or objects, called *fetishes* (Fig. 72), are worshipped because they are believed to possess magic power. Among these objects are included fire, the sun, the earthquake, and many animals. So far as God is concerned, if these people have any conception of Him, it is of the crudest kind. The negroes, the Indians, the Eskimos, and even our own ancestors two thousand years ago had little more than this form of religion.

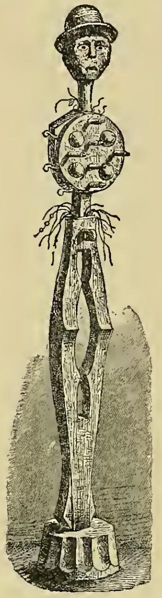


Fig. 72.
A fetish from Africa.

Most races believe in a future life, though often vaguely, and as their only way of explaining the mystery of death. The Indians, for example, think that upon death the human spirit goes to a happier place, where conditions are somewhat similar to those on earth. They therefore bury hunting implements with the dead. All people with such views as the preceding are called *heathens* (Fig. 74), and are often said to have no religion. From our point of view they have no *true* religion; but they have something akin to it.

Among the semi-civilized and civilized races there are forms of belief in which the conception of God is higher, and the idea of future reward and punishment is taught. Of these religions five call for special mention.

Buddhism, followed especially in eastern Asia (Fig. 74), was established in India five or six hundred years before the time of Christ as a result of the work and teachings of Buddha (Fig. 73). But there are many differences in the religious beliefs and customs of the Asiatic people, and in consequence there are many sects. *Brahminism* is one of the most common forms of belief, being especially followed in India. It would be difficult correctly to describe the religions of the Asiatic people in a few words; but *idolatry*, or the worship of idols, is prevalent among them. Ancestor worship is common in China; and the doctrine of caste in India, — that is, the doctrine of class distinction. Both of these doctrines, which are a part of their religion, are opposed to progress, as we shall see.

FIG. 73.
A statue, or idol, of Buddha in India.

The *Jewish* religion, still followed by many, upholds the worship of one righteous God, as taught in the Old Testament. From this, two other religions have developed, *Mohammedanism* and *Christianity*. The prophet Mohammed lived about six centuries after Christ, and the *Koran* contains his teachings. Mohammedans deny the divinity of Christ. This religion has been spread by the sword with wonderful rapidity, especially among the semi-civilized people of Asia and Africa (Fig. 74). Many of its followers became fanatics who, believing that they thus obtained future happiness, willingly died if they could die killing a Christian.

The Christian religion, the common belief in America and most of Europe, has spread slowly, but it now num-

Fig. 74.

Diagram to show the distribution of religions. So small a map is of course only true in general — for example, it must omit many of the small sections where Christian missionaries have made converts.

bers about 440,000,000 followers. Its success, however, must not be measured by numbers alone; for Christians make up most of the really civilized people of the world (Fig. 74). It is no accident that this is so, for Christianity has been one of the chief factors in making civilization possible.

Religious belief has had much to do with inventions and the growth of industry. The Chinese, for example, have long opposed new inventions because their ancestor worship cultivated undue reverence for past customs; also they have been unwilling to dig into the ground, for fear of disturbing the evil spirits that are supposed to dwell there. Partly for such reasons, our study of geography is chiefly concerned with Christian countries; for there we find the most varied and extensive uses of the earth in the service of man.

Questions. — (1) Tell about the Ethiopians; their characteristics and distribution. (2) Do the same for the American Indians. (3) Mongolians. (4) Caucasians. (5) Give reasons for the greater advance of the Caucasians. (6) What is believed about the early development of civilization? (7) How is food obtained by natural races? (8) Tell about the development of agriculture. (9) Of grazing. (10) What is the effect of the mixture of farming and nomadic races? (11) What influence has the development of fishing had upon civilization? (12) In what kind of regions has the greatest advance of mankind taken place? Why? (13) How do natural races secure shelter? Give examples. (14) What influences aid in the selection of sites for homes? For towns and cities? (15) What materials are employed in clothing? (16) What is known about the origin of speech and written language? (17) Give examples of early inventions. (18) What inventions have been especially important? (19) Tell about the simplest forms of government. (20) The more advanced forms. Give examples. (21) Tell about the development of religion. (22) Give some facts about Buddhism and Brahminism; Jewish religion; Mohammedanism; Christianity.

Suggestions. — (1) What members of the divisions of mankind — other than whites — have you seen in your own neighborhood? (2) What different nationalities of whites? (3) Find pictures illustrating human life in the various zones. (4) Help to make a collection of pictures for the school to illustrate the various forms of shelter and clothing. Also find such pictures in this book. (5) Find some one who has specimens of primitive implements, as Indian arrowheads, and examine them. (6) Find out something about the ways in which savage races ornament their clothing and person.

EUROPE

PHYSIOGRAPHY, CLIMATE, AND PEOPLE

Physiography

Highlands and Lowlands. — As in the case of North America, the development of the continent of Europe has required millions of years. Far back in time mountains appeared above the sea in the northwestern portion of the

Fig. 110.

A view over the snow-capped peaks of the Caucasus Mountains. A sea of fog fills the valley.

continent. Although greatly worn by the weathering of the ages, and much reduced in elevation, these mountains may still be seen in Finland, Scandinavia (the peninsula occupied by Norway and Sweden), and Scotland (Figs. 127 and 129), as well as in Germany and Belgium. They resemble the mountains of New England and eastern Canada, that have likewise been greatly worn by weathering.

Other mountain ranges were later formed in southern Europe; but, like those of western America, they are young and their recent growth has been vigorous. There-

Fig. 111.
Lake Geneva in a valley among the Alps. The Rhone River flows out of this lake.

fore the *Pyrenees* (Fig. 155), *Alps*, and *Caucasus* (Fig. 110) are still of great height. Find each on Figure 109. The mountains of North and South America form continuous chains, with the highest mountains in the west, extending north and south. But in Europe the loftiest mountains are in the south, extending in various directions, though mainly east and west. How does this condition promise a different effect on the climate? It is to the fact that the mountains are not continuous, and that they consist of chains extending in various directions, that Europe owes much of its extremely irregular outline.

Besides the mountains mentioned, there is a long, low chain, known as the *Urals,* which extends north and south on the eastern side, and for a part of the distance forms the boundary between Europe and Asia. Other scattered highlands are shown on Figure 109. Where mainly are they situated?

Next to the Caucasus (Fig. 110) the loftiest of all these mountains are the Alps (Figs. 111, 201, 204, and 205), whose rains and snows find their way to the sea through several of the large rivers of Europe. What are some of their names (Fig. 172). Headwaters of four of these rivers are within forty miles of each other in the Alps. What large rivers of Europe do not rise in the Alps (Fig. 109)?

Between the low mountains of the north and east and the higher ranges of the south there is a very extensive lowland (Fig. 109). A part of this has been submerged by the sinking of the land, thus forming the shallow Baltic Sea. Beginning in the west with southern England, and passing through Belgium and Holland, or the "Low Countries," this plain broadens as it extends eastward across Germany (Fig. 112) until it includes almost all

Fig. 112.
Looking across the level plain of North Germany. Peat is dug on this plain near the river.

of Russia (Fig. 109). Estimate its length east and west. About two-thirds of Europe is included in this plain.

Some of the streams in the mountains, as in Scandinavia and Switzerland, have abundant water power; but most of the rivers flow with gentle slope over broad plains. As a result, most of the rivers are navigable for long distances; for example, the Seine for 350 miles and the Rhine for 550 miles. The level plains also encourage the building of canals; and thus, by river, canal, and lake, the Black and Caspian seas are connected with the Baltic and North seas; and the North and Caspian seas are connected with the Mediterranean.

Coal Beds. — While these mountains and plains were forming, coal beds were also accumulating, as was the case in America during the *Coal Period*.

Vast swampy tracts were covered with a luxuriant vegetation; then this land was lowered beneath the sea, and the plant remains became covered over and pressed closely together by the weight of thick layers of sand, gravel, and mud. After a while the sea bottom emerged once more, and rank vegetation returned, but this time with its roots in the ocean mud that had buried the earlier swamps. In the course of hundreds of years the land again sank and the plants were covered much as before. Thus one layer of dense vegetation after another was buried deep in the earth; and there it has slowly changed to the coal that is of so much use in warming houses, cooking food, and running machinery.

Figure 113 shows the parts of Europe in which coal beds occur. In what countries are they? Most of the coal is *bituminous* or soft coal, though there is some *anthracite*. In a number of sections *lignite* or brown coal is mined. This is a poor variety formed in much the same way as the bituminous, but at a later time than the Coal Period. *Peat* (Fig. 112) is also dug for fuel in western Europe, where the damp climate favors its formation.

The Great Ice Sheet. — At the same period that eastern North America was invaded by a great ice sheet from the north, snow accumulated on the highlands of northwestern

Fig. 113.
Coal map of Europe.

Europe and spread outward in all directions. Figure 114 shows the extent of the European ice sheet.

One glacier, with its centre in the Scandinavian peninsula, spread southward over the Russian plains, and into Germany and Holland. Smaller ice sheets were developed in the highlands of Scotland, Ireland, and Wales; and these, united, covered all the British Isles, excepting the extreme southern part (Fig. 114). The British glaciers also flowed out into the North Sea and joined forces with the Scandinavian glacier.

During this same period the glaciers of the Alps and other mountains were much more extensive than now, extending far down the mountain valleys. These facts are known by the deposits of drift that the ice left, by the boulders and pebbles

FIG. 114.
Ice sheet.

that the glacier moved, and by the scratches that were made on the rock as the ice dragged these fragments along.

In Europe, as in North America, the ice cap was over a mile thick; and when it slowly moved over the surface it swept away the soil that had accumulated, and ground the rock fragments to bits. These bits of rock it deposited elsewhere as *drift*, so that, while the bed rock was left bare in some places, in others it was covered with a deep glacial soil containing boulders and pebbles. In many places the drift blocked the stream valleys and thus caused innumerable falls and small lakes. In Figure 109 note the distribution of lakes in Europe (see also Figs. 122 and 200). The greater number of these lakes are too small to be shown on our maps. Of what service are lakes and falls to man?

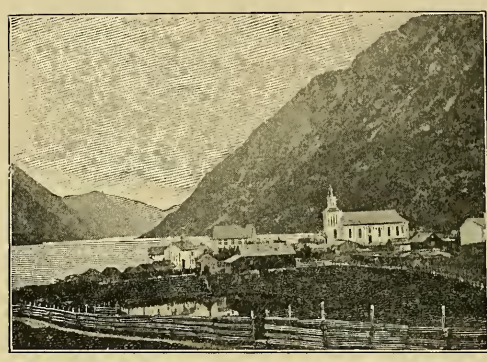


Fig. 115.

A *fjord* on the coast of Norway — a mountain valley into which the sea has been admitted by sinking of the land. (See also Fig. 173.)

The Coast Line. — The irregularities of the coast line of northern Europe, like those of northeastern North America, are due to the sinking of the land. The Baltic Sea and its gulfs represent old land valleys; and the hills of this submerged land form either islands, peninsulas, or shallow banks where food fish abound.

It seems to be well proved that, before the Glacial Period, the British Isles were connected with the mainland by low plains where the North Sea and English Channel now exist. An elevation of only a few hundred feet would restore this condition by changing the bed of the North Sea to dry land. This would then extend the continent westward beyond the British Isles, thus destroying the bays and harbors, and altering the entire outline of northwestern Europe.

In southern Europe the rising and sinking of small areas of land — while the mountains were forming — has made many peninsulas, with bays, gulfs, islands, and seas between. The Mediterranean itself occupies a basin, thousands of feet in depth, formed by the sinking of this part of the earth's crust. Some of these islands, however, are partly or wholly built up by volcanic action. What volcano is on the island of Sicily (Fig. 200)?

As a result of all these land movements, Europe has the most irregular coast of all the continents. Name its large peninsulas. How many of them are mountainous? Name the larger gulfs and seas that border the continent. How about the number of fine harbors? Show by examples how this great irregularity of the coast is of advantage in allowing vessels to proceed far into the interior of the continent.

Climate

Influence of Latitude. — Trace the 50th parallel of latitude on a globe or map of the world. Notice that while the 49th parallel forms the northern boundary of western United States, it passes entirely south of England, crosses France near Paris, and extends through southern Germany and Russia. From this it is evident that by far the larger part of Europe lies farther north than the United States, and due east of Canada. St. Petersburg is in the same latitude as northern Labrador; and the tips of the peninsulas of southern Europe reach about as far south as the southern boundary of Virginia.

In the far north, near the Arctic, the climate is bleak, and there are barren, frozen tundras. South of this is a belt of fir, spruce, and pine, like that which stretches east and west across central Canada. But contrary to what might be expected from latitude alone, the climate in and just south of this belt of evergreen forest permits the

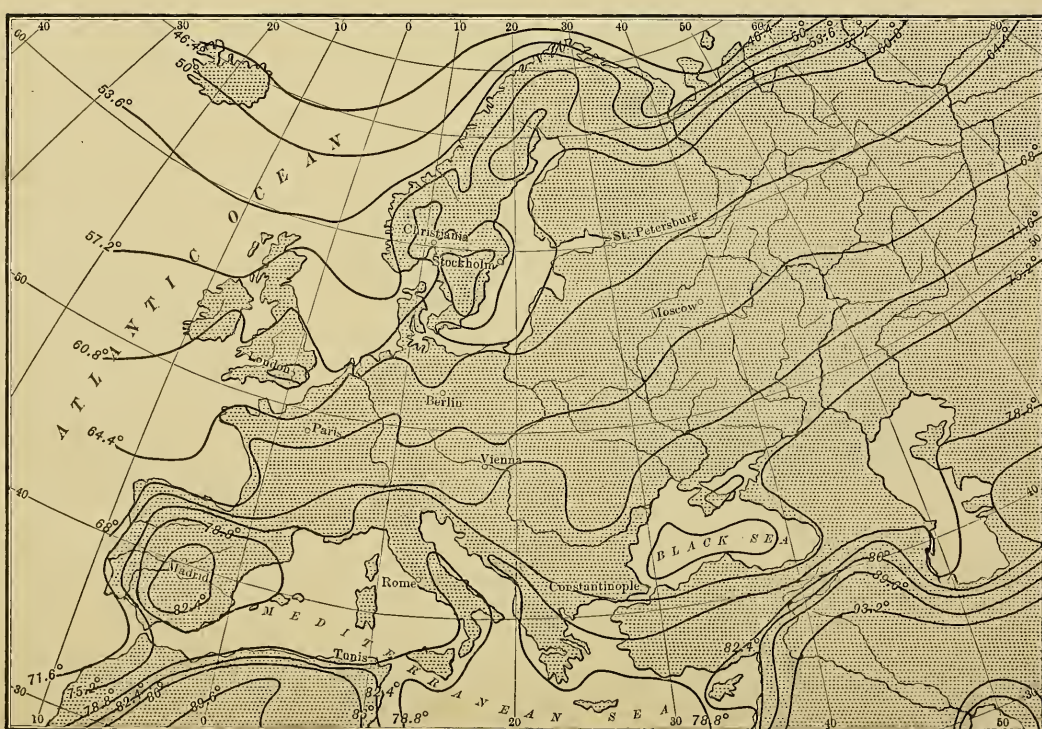


Fig. 116.

Isothermal chart of Europe for July. (The figures are given for tenths of degrees Fahrenheit — for example 60.8 — because the map was made from one in which the Centigrade scale was used.)

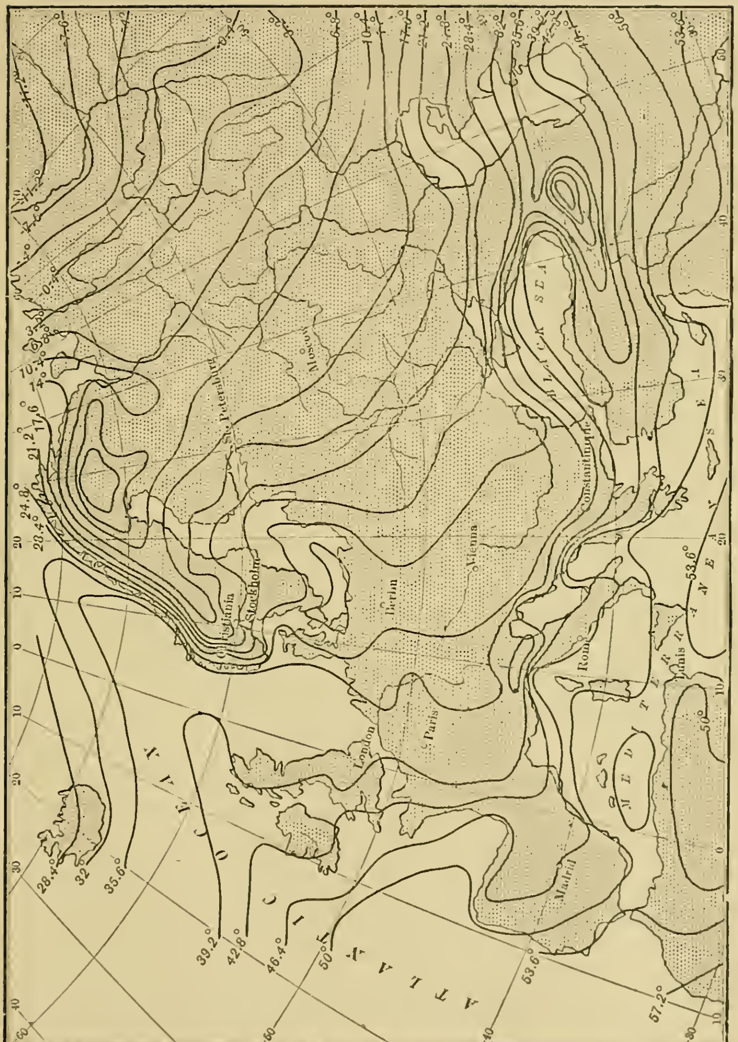


FIG. 117.
Isothermal chart of Europe for January.

growth of the grains and fruits that flourish in southern Canada and northern United States. In southern Europe, in the latitude of central United States, such semi-tropical fruits as oranges, lemons, olives, and figs are cultivated. That is to say, the products of the greater part of Europe are such as grow several hundred miles farther south in eastern North America.

That these products are raised in great abundance in Europe is indicated by the number of people there ; for, although the continent is much less than half the size of North America, it supports four times as many inhabitants, or nearly 400,000,000. Let us see the explanation of these remarkable facts.

Resemblance to Western North America. — In several respects the climate of Europe is so similar to that of western North America that a brief review will be useful. It will be recalled that our western coast, north of San Francisco, is under the control of the prevailing westerlies (Fig. 25). These winds from the Pacific so temper the cold of winter and the heat of summer as to produce a very mild climate for some distance inland ; but toward the east, or interior, the influence of the ocean decreases and the extremes of temperature become greater. South of San Francisco the influence of the horse latitudes and the trade-wind belts is felt, and whatever wind there is, usually blows either along the coast or from the land.

The vapor-laden westerlies, rising over the highlands north of San Francisco, cause an abundance of rain, so that western Washington and Oregon have the heaviest rainfall in the United States. In crossing the mountains, however, the winds are so deprived of moisture that the plateaus and plains beyond are arid (Fig. 30). Southern

California has rain in winter, especially in the mountains ; but in summer, when the trade-wind belt has moved northward (Figs. 31 and 32), the winds blow either along the coast or from the land. Therefore the climate is so dry that agriculture can be carried on only by irrigation.

Now turn to northern Europe. The prevailing westerlies are felt there as in the United States. Blowing from the ocean, and, what is especially important, from across the warm ocean current (p. 50), they distribute an enormous amount of heat over the land. It is the westerlies from these warm waters, more than any other factor, that allow crops to be raised nearer the pole in Europe than in any other part of the globe. If these conditions were not present, much of that densely populated continent (Fig. 120) would be a barren waste, like Labrador.

The effect of the ocean winds is naturally greatest near the coast, as in western North America. Therefore England has a mild, rainy climate ; but the farther eastward one goes, the less is the influence of the ocean. Thus eastern Russia experiences great extremes of heat and cold, and there is danger of serious droughts. Compare the summer and winter temperature (Figs. 116 and 117) and the rainfall (Fig. 118) of these two sections.

Southern Europe, like southern California, is not affected by the westerlies in summer, for it lies then within the belt of the horse latitudes. This accounts for the fact that southern Spain, Italy, and Greece receive very little rain in summer. Examine Figure 118 to see where in Europe the rainfall is light. Find some places where there is abundant rain on mountain slopes.

Influence of Cyclonic Storms. — Thus far we have seen a striking resemblance in the climates of the two continents. But there are also notable differences. The westerlies are less regular in Europe than in western North America because of frequent interruption by the cyclonic storms, which, after passing over eastern North America, often cross the ocean and continue across Europe (p. 35). Why cannot their arrival be predicted as well as in the United States?

As in eastern United States and Canada, the cyclonic storms cause variable winds (Fig. 35). For example, when a storm centre is west of the British Isles the westerlies are checked and the winds blow toward the centre, or *from the east*. But while storm winds from the east bring rain to eastern North America, the same kind of winds cannot bring rain to eastern Europe, because there is no great ocean near at hand to supply the vapor. On account of the absence of ocean water, therefore, eastern Europe has little rain, as eastern America would have if there were land instead of water to the east of it.

Effect of Mountain Ranges. — The direction in which the highlands extend is a second cause of great difference between the climates of Europe and America. In America, where high mountains extend north and south along the entire western margin of the continent, the warm, damp westerlies are soon deprived of their moisture. This leaves a vast arid and semi-arid area in the interior.

In Europe, on the other hand, where the higher ranges extend nearly east and west, the mountains do not so seriously interfere with the movement of vapor to the interior. Consequently the west winds surrender their moisture only very gradually. This accounts for the fact that in the belt of westerlies, from western Ireland to eastern Russia, there is rainfall enough for agriculture.

The east-west direction of the lofty mountains has a marked influence on the climate of those portions of Europe that lie on their north and south sides. Rising like great walls, the mountains prevent south winds from bearing northward the heat of the Mediterranean basin; and they also interfere with the passage of the chilling winds from the north. We know that Florida, much farther south than southern Europe, is

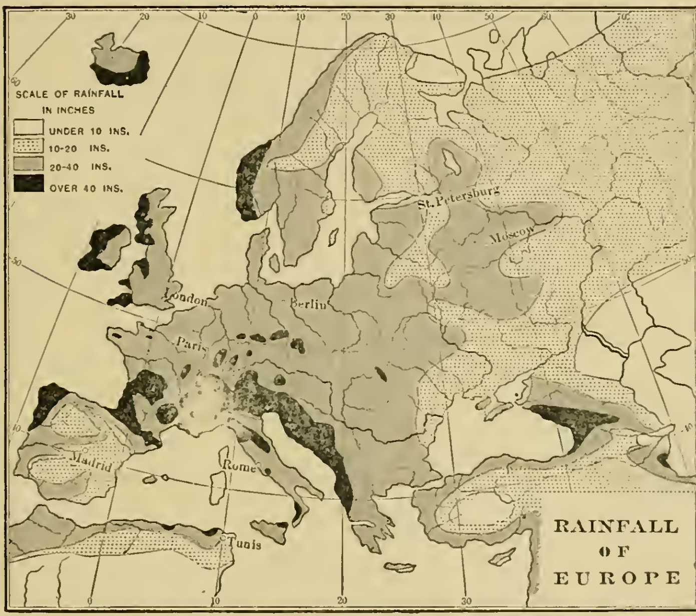


FIG. 118.

visited by cold waves and accompanying frosts; but mountain barriers prevent such winds in portions of southern Europe.

Inland Seas. — The numerous inland seas are another great factor in influencing the climate of parts of Europe. Draw a sketch map of Europe, locating these seas. How does the Mediterranean compare in length with Lake Superior? It will be remembered that our Great Lakes produce a marked influence on the climate of the neighboring land, moderating the heat of summer and the cold of winter. It is this influence, added to that of the mountain barrier, that gives to southern Italy, Greece, France, and Spain such an equable and almost tropical climate. How must these seas influence the rainfall?

THE UNITED STATES COMPARED WITH OTHER COUNTRIES

Area and Population. — In spite of the vast extent of the United States, there are three empires in the Old

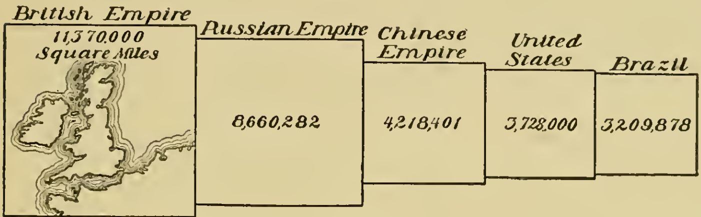


Fig. 401.
Area of the five largest nations.

World with a greater *area*. Which are they? (Fig. 401). Which country is fifth in size? Compare the United States with each of these in area.

The United States also ranks fourth in *population* (Fig. 402). Name the five most populous countries in the

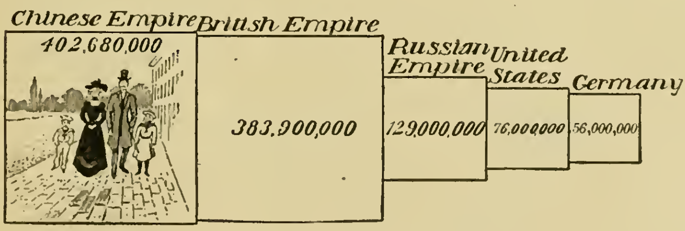


Fig. 402.
The five most populous nations, 1900.

order of their rank. What facts do you discover by comparing Figures 401 and 402? Figure 403 shows the *density of population*, or the number of people per square mile, in some of the countries in the world. From this it will be seen that the United States is very thinly settled compared with many countries. Compare the United States in this regard with Belgium, England, Cuba, Mexico, and Canada.

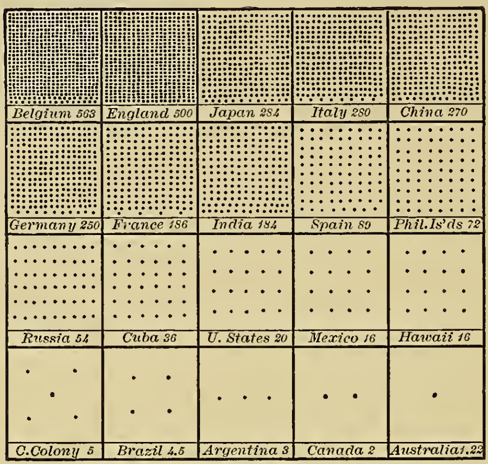


FIG. 403.

Density of population of some of the countries.

Leading Raw Products.—Nevertheless, the United States leads the world in many very important respects and approaches leadership in several others. Figure 404 shows that no nation is a

FIG. 404.

Sketch map to show the approximate distribution of corn.

close rival to us in the production of *corn*. What countries, however, raise large quantities of it? Why is no

Fig. 405.
Approximate distribution of wheat.

corn raised in the British Isles? (p. 181). *Wheat* is more widely cultivated than corn (Fig. 405). Yet we are far

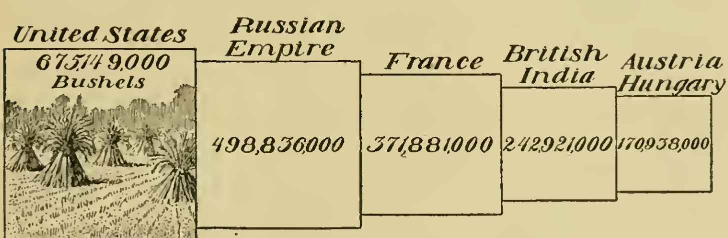


Fig. 406.
The five leading wheat-producing countries, 1898.

in the lead in that grain (Fig. 406). Point out (Fig. 405) the leading wheat fields of the world. Which sections are important for both wheat and corn? On which side of the Atlantic is wheat raised farthest north? Why?

Cotton is limited to warm climates (Fig. 407), so that comparatively few countries raise it. Name the five that lead in its production (Fig. 408). To what extent does the

FIG. 407.
Approximate distribution of cotton.

output of the United States surpass that of the four other countries together? In what parts of the United States is most *cotton manufacturing* carried on? What other countries have important cotton-manufacturing industries?

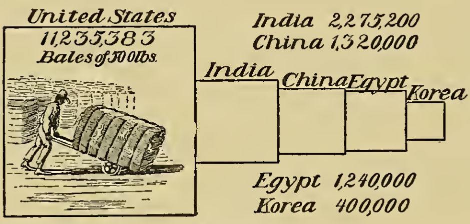


FIG. 408.
The five leading cotton-producing countries, 1898.

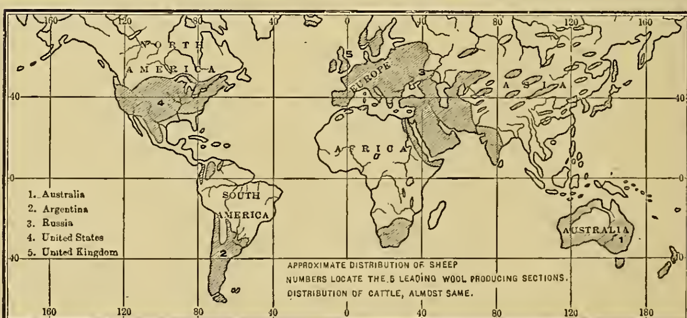


FIG. 409.
Approximate distribution of sheep.

Note the distribution of *sheep and cattle* (Fig. 409). What is our rank in the production of *wool?* (Fig. 410).

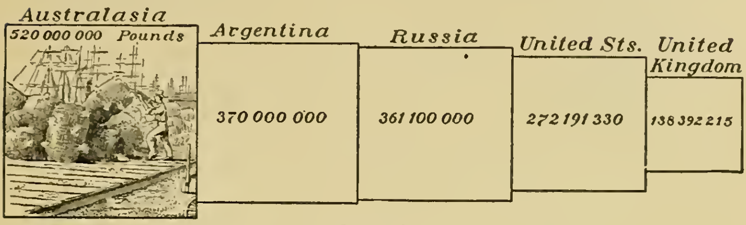


FIG. 410.
The five leading wool-producing countries, 1899.

Yet we consume much more than we raise. Recall some facts concerning sheep raising in Australia, Argentina, and the United States. What nations have important *woollen manufacturing?*

The extreme importance of *coal and iron for manufacturing* purposes has often been emphasized. But Figure

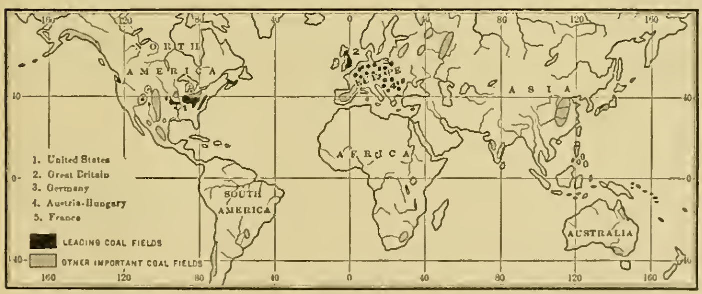


FIG. 411.
Approximate distribution of coal.

411 represents the *coal fields* as very limited. What countries have little or none? Name the leading coal-producing sections, and state the rank of the United States in this mineral (Fig. 412).

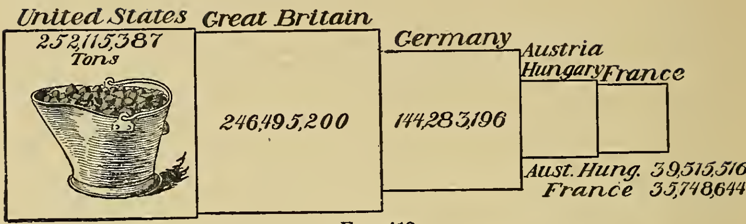


FIG. 412.
The five leading coal-producing countries, 1899.

Is *iron ore* more or less widely distributed than coal? (Fig. 413). How does the United States rank in the

FIG. 413.
Approximate distribution of iron mines.

output of this mineral (Fig. 413); also in the production of *pig iron* (Fig. 414), which demands coal as well as

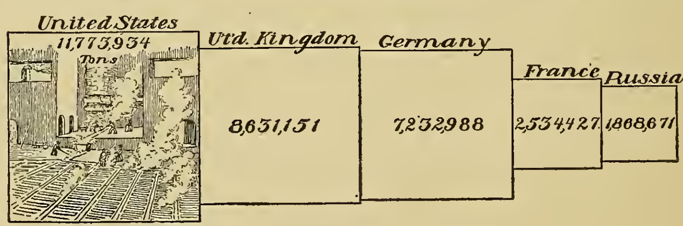


FIG. 414.
The five leading countries in the production of pig iron, 1898.

iron ore? How does the output of coal and iron correspond to the importance of countries as manufacturing nations? (Fig. 421).

Where are the principal *silver*-mining sections? (Fig. 415). And how do we compare with other countries

FIG. 415.
Approximate distribution of silver mining.

in this product? (Fig. 416). Notice to what extent the world is indebted to the New World for silver. Tell

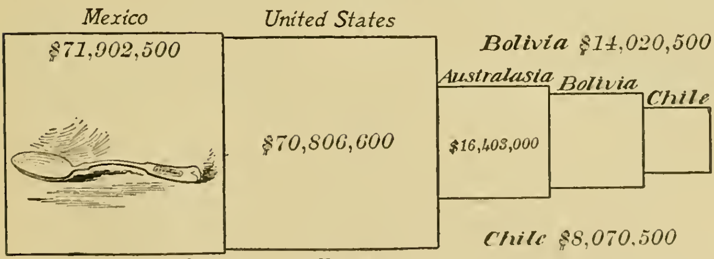


FIG. 416.
The five leading silver-producing countries, 1899.

about the distribution of *gold* (Fig. 417) and give our rank in the production of that metal (Fig. 418). How does the value of the total gold production compare with that of silver in the five leading regions for each?

Figure 419 suggests that the United States leads the world in the production of *petroleum*, or mineral oil, which

FIG. 417.

Approximate distribution of gold mining.

is true. The second most important district for petroleum is in Russia near the Caspian Sea. Other districts pro-

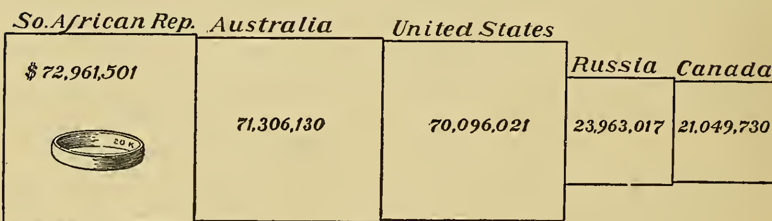


FIG. 418.

The five leading gold-producing countries, 1899.

duce little petroleum. On the same map with petroleum is shown the distribution of *rubber*. To what countries and climates is rubber confined? (Fig. 419).

Manufacturing and Commerce. — According to Figure 420 on what two continents is there the greatest development of *manufacturing?* What other smaller sections are active in this industry? Considering the abundance of our raw materials and the energy and intelligence of our people,

FIG. 419.

Approximate distribution of petroleum; also of rubber.

FIG. 420.

Approximate distribution of manufacturing.

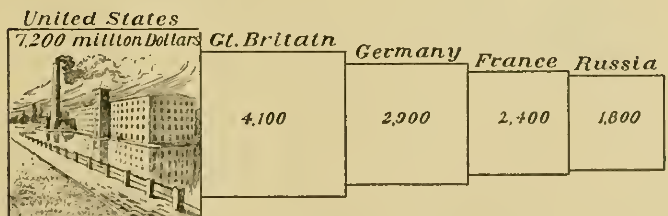


FIG. 421.

The five leading manufacturing countries, 1888.

it is not surprising that we surpass all other countries in such work (Fig. 421). State the rank of other leading nations in this occupation.

In provision for *transportation by rail* the United States also takes the leading place. It has by far the greatest number of miles of railway of any nation (Fig. 422),

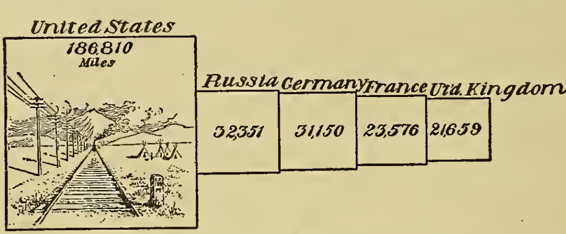


Fig. 422.
The five countries having the greatest length of railways, 1898.

though several small European countries have a greater development of railways in proportion to their area. The United States ranks second in provision for *transportation by water* (Fig. 423). State the rank of the five

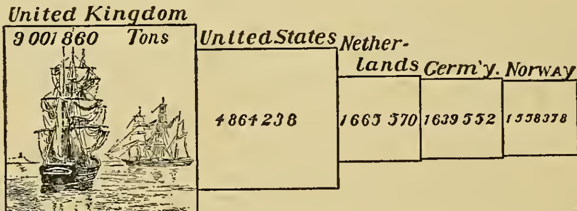


Fig. 423.
The five countries having the largest merchant marine, 1898.

chief countries in total length of *railways*, and in *merchant marine*. Give reasons why the United Kingdom should lead in merchant marine (p. 201). Why should Norway be of importance in this respect? (p. 255).

All these facts prepare us for Figure 424, which shows that the United States is the *wealthiest nation* on the

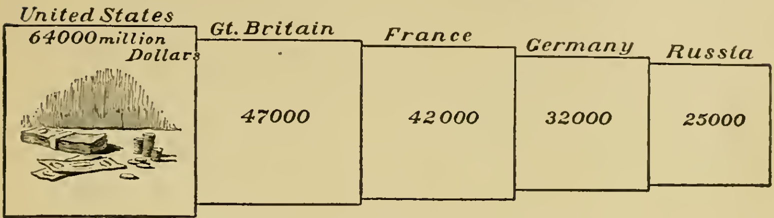


FIG. 424.
The five wealthiest nations, 1888.

face of the earth. Compare our wealth with that of other leading countries. In how many and what respects have our products and industries been shown to lead all nations of the world?

Dependence upon Other Nations. — All together the United States may be considered a wonderfully favored and independent nation, since it has such a wealth of raw products, and such an extensive development of manufacturing. We could, probably, better than any other nation, depend upon ourselves alone for all that we need, if occasion should arise. Yet so closely related are the nations of the world that if war arises between two of them, our industries and markets are affected. This is due largely to the fact that we produce far more than we need of certain commodities, as wheat, cotton, meat, and iron, for which a market must be found abroad. These we *export*. But it is also due to the fact that we are partly, or wholly, dependent upon foreign countries for certain other articles. These we *import*.

For example, Figure 425 shows that *coffee* is not grown within our states, although it is daily consumed in almost

R

FIG. 425.
Approximate distribution of coffee.

every household. Notice, however, that it is produced in Cuba, Porto Rico, and the Philippine Islands (Fig. 425). To what climate and countries is it confined? State the rank of the principal coffee-producing sections and compare their output (Fig. 426).

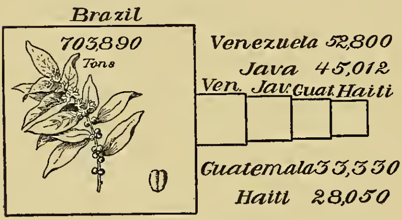


FIG. 426.
The five leading coffee-producing sections, 1899.

Note the *beet sugar* and *cane sugar* areas (Fig. 427). Also the

FIG. 427.
Distribution of sugar cane and beet sugar.

rank of the leading countries which manufacture cane sugar (Fig. 428). Our own states produce far less sugar

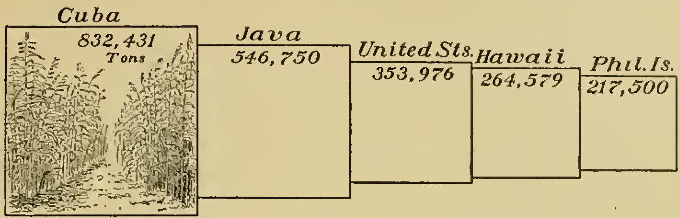


FIG. 428.

The five countries producing most cane sugar, 1898.

each year than we consume. Of what importance, therefore, in this respect is our newly established relation to Cuba and the Hawaiian and Philippine Islands?

Figure 429 represents us as depending wholly on foreign nations for raw *silk*. Name the chief silk-producing coun-

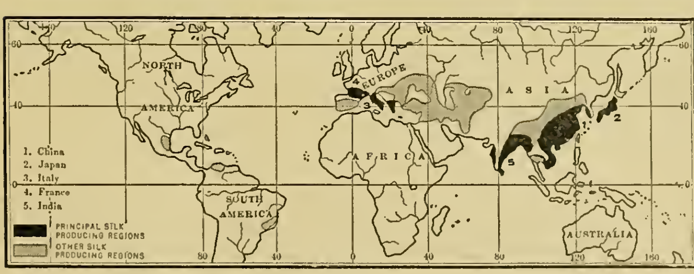


FIG. 429.

Approximate distribution of raw silk production.

tries; also compare their output (Fig. 430). Our *tea* also comes almost entirely from abroad (Fig. 431). From what region mainly? And while much *rice* is produced in our Southern States (Fig. 432), a large amount has to be imported. From what sources must it be obtained? We have, therefore, a very extensive trade in *imports* as well as in *exports*.

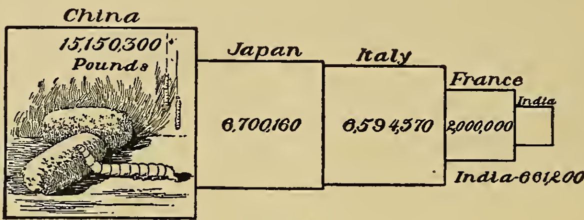


FIG. 430.

The five leading raw silk-producing countries, 1899.

FIG. 431.

Approximate distribution of tea.

FIG. 432.

Approximate distribution of rice.

Exports and Imports. — Our ten leading exports, named in order of value, together with the principal countries to which the goods are sent, are as follows: —

Articles	Value in 1900	Principal Countries to which they are sent
1. Cotton (mainly unmanufactured)	$265,836,000	Gt. Britain, Germany, France, Japan.
2. Breadstuffs (wheat, corn, flour, etc.)	262,744,000	Gt. Britain, Germany, Netherlands, Belgium.
3. Meat and dairy products	184,453,000	Gt. Britain, Germany, France, Belgium.
4. Iron and steel, and manufactures of	121,914,000	Gt. Britain, Canada, Germany, Mexico.
5. Mineral oils	75,612,000	Gt. Britain, Germany, Netherlands, Belgium.
6. Copper (mainly manufactures of)	57,853,000	Gt. Britain, Netherlands, France, Germany.
7. Wood, and manufactures of	50,598,000	Gt. Britain, Canada, Germany, W. Indies.
8. Animals (mainly cattle)	43,585,000	Gt. Britain.
9. Tobacco	35,433,000	Gt. Britain, Germany, Italy, France.
10. Leather, and manufactures of	27,293,000	Gt. Britain, Australasia, Canada.
Total value of exports	$1,394,484,000	

The ten leading imports, on the other hand, are as follows: —

Articles	Value in 1900	Principal Countries from which they come
1. Sugar and molasses	$101,141,000	E. Ind., Hawaiian Isds., Cuba, Germany (beet sugar).
2. Silk, and manufactures of	76,224,000	Japan, France, China, Italy.
3. Hides and skins	57,936,000	E. Indies, S. America, Gt. Britain, France.
4. Fibre, and manufactures of	57,933,000	Mexico, Philippines, E. Indies.
5. Chemicals, drugs, etc.	53,705,000	Germany, E. Indies, Gt. Britain.
6. Coffee	52,468,000	Brazil, Cent. America, E. Indies, Mexico.
7. Cotton (mainly manufactures of)	49,502,000	Gt. Britain, Germany, Switzerland, France.
8. Wool, and manufactures of	36,425,000	Gt. Britain, Germany, France, S. America.
9. Rubber and rubber goods	33,860,000	Brazil, Gt. Britain.
10. Fruits and nuts	19,264,000	Italy, Cent. America, W. Indies.
Total value of imports	$849,941,000	

In Figure 433 trace the main *steamship lines* of the world by which these goods are carried. Compare the value and nature of our exports and imports. How is the result encouraging?

More than one-third of all our foreign trade is with the British Isles, the ten leading countries ranking as follows:—

THE LEADING TEN COUNTRIES WITH WHICH THE U.S. TRADES

Countries		Value in 1900	Kinds of Goods
1. British Isles	Exp.	$533,820,000	Provisions, breadstuffs, raw cotton.
	Imp.	159,582,000	Cotton goods, raw wool, tin, jewellery, rubber goods.
	Total	693,402,000	
2. Germany	Exp.	187,348,000	Raw cotton, breadstuffs, provisions.
	Imp.	97,375,000	Beet sugar, chemicals and drugs, cotton goods, silk goods.
	Total	284,723,000	
3. France	Exp.	83,335,000	Raw cotton, copper, mineral oil.
	Imp.	73,012,000	Silk goods, hides, jewellery, cotton goods.
	Total	156,347,000	
4. Canada	Exp.	97,337,000	Coal, breadstuffs, cotton and manufactures of.
	Imp.	39,932,000	Lumber, coal, hides.
	Total	137,269,000	
5. Netherlands	Exp.	89,387,000	Breadstuffs, provisions, copper, mineral oil.
	Imp.	15,853,000	Jewellery, tin.
	Total	105,240,000	
6. West Indies	Exp.	48,561,000	Provisions, breadstuffs, animals.
	Imp.	52,562,000	Sugar, fruits, cocoa.
	Total	101,123,000	
7. East Indies	Exp.	6,634,000	Mineral oil, cotton goods.
	Imp.	73,243,000	Sugar, hides, tin.
	Total	79,877,000	
8. Brazil	Exp.	11,578,000	Breadstuffs, mineral oil, provisions.
	Imp.	58,073,000	Coffee, rubber, sugar.
	Total	69,651,000	
9. Mexico	Exp.	34,975,000	Coal, cotton goods, iron and steel manufactures.
	Imp.	28,646,000	Sisal grass, coffee, lead, hides.
	Total	63,621,000	
10. Japan	Exp.	29,087,000	Manufactured cotton, mineral oil, iron and steel manufactures.
	Imp.	32,749,000	Silk, tea.
	Total	61,836,000	

Name some of the countries which probably have the same exports as the United States, and which are, therefore, likely to be active rivals to us in supplying foreign markets.

Owing to our trade relations with the United Kingdom, what hardships would probably be brought upon the British if they entered upon a war with us? How might the Germans

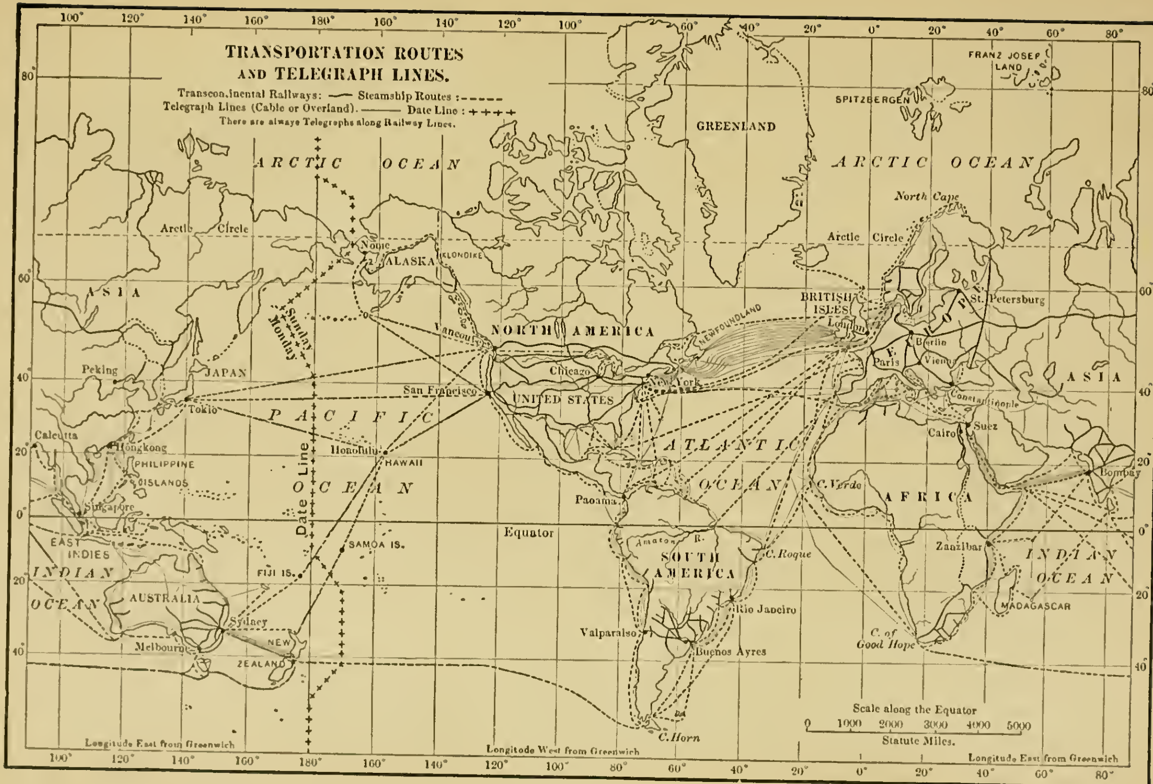

TRANSPORTATION ROUTES
AND TELEGRAPH LINES.
Transcontinental Railways: —— Steamship Routes : - - - - -
Telegraph Lines (Cable or Overland). ———— Date Line : + + + +
There are always Telegraphs along Railway Lines.
ARCTIC OCEAN
ARCTIC OCEAN
GREENLAND
SPITZBERGEN
FRANZ JOSEF LAND
North Cape
Arctic Circle
Arctic Circle
ASIA
ASIA
ALASKA
KLONDIKE
Nome
Sunday
Monday
JAPAN
Peking
Tokio
Calcutta
Hongkong
PHILIPPINE ISLANDS
Singapore
EAST INDIES
INDIAN OCEAN
INDIAN OCEAN
AUSTRALIA
Sydney
Melbourne
NEW ZEALAND
FIJI IS.
SAMOA IS.
Honolulu
HAWAII
PACIFIC OCEAN
Date Line
Vancouver
San Francisco
NORTH AMERICA
Chicago
UNITED STATES
New York
NEWFOUNDLAND
Panama
Equator
ATLANTIC OCEAN
SOUTH AMERICA
Amazon R.
C. Roque
Rio Janeiro
Valparaiso
Buenos Ayres
C. Horn
BRITISH ISLES
London
Paris
Berlin
Vienna
St. Petersburg
Constantinople
Cairo
Suez
Bombay
C. Verde
AFRICA
Zanzibar
MADAGASCAR
C. of Good Hope
Scale along the Equator
0 1000 2000 3000 4000 5000
Statute Miles.
Longitude East from Greenwich
Longitude West from Greenwich
Longitude East from Greenwich

FIG. 433.

suffer if they were at war with us? How might the French suffer? On the other hand, what hardships would come to us in each case? Are we more or less independent than these countries in case of such war? Why?

Reasons for the Rank of the United States. — The preceding figures and diagrams show that several European countries are the chief competitors with the United States in the *world's trade*. Give examples. But so far as the future is concerned, several important facts are in our favor. In the first place, we are still in our youth as a people, while some of the leading nations of Europe have perhaps already reached the zenith of their power. In the second place, the territory of most of those countries is densely populated, as shown in Figure 403. Note the number of inhabitants per square mile in Belgium, Germany, and France. When we contrast with these figures our average of only twenty persons per square mile, the possibility of our future growth seems almost without limit. Immense tracts of land, which in Europe would be carefully tilled, are in our country not even cleared for pasture; and in no large section of the United States do we even approach the careful hand tillage of Belgium and some other European countries.

Another point in our favor is the varied climate and physiography of our vast country, encouraging varied products. Almost all farm products can be raised with little care in our rich soil and favorable climate. Add to this the wonderful mineral resources, which are apparently not equalled on any continent, and it will be seen that our natural resources, which have made present development possible, promise equally for the future.

Our people are another element to be considered in reckoning past success and future promise. They have consisted, in large part, of those who had energy and ambition enough to migrate to a new land in the hope of bettering their condition. In their new home the possibilities have been so great that they have been encouraged to work and to improve themselves. As the environment of the desert has given rise to the nomad, and the ease of life in the tropical forest to the degenerate savage, so the environment in the United States has given rise to a race noted for its energy and enterprise. This race has been possible, however, largely by reason of the fact that it comes from a mixture of peoples already gifted. That resources alone will not make an energetic people and a great nation is well illustrated in China, where nature favors, but racial characteristics and customs are opposed to development.

Nor would the statement of reasons for the present position of the United States and her future prospects be complete if left here. There are two other elements of high importance; namely, education and government. Where people are hampered by ignorance, petty restrictions, and heavy taxes, unnecessarily imposed upon them by their rulers, they have little opportunity for progress. It is those European countries in which there are the best opportunities for education and the greatest freedom, that have made the greatest progress. And no nation in the world pays more attention to education, or guarantees its people a more active part in their entire government, than the United States.

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